THE

ELECTRICAL REVIEW.

VOL. LVIII. MAY 18, 1906. No. 1,486.

ELECTRICAL REVIEW.

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THE ELECTRICAL REVIEW.

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THE

UNIVERSAL ELECTRICAL DIRECTORY

1906 Edition

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NAVAL TRAINING.

THE innumerable friends of Prof. Ewing in the electrical world will desire this week to offer him their cordial congratulations upon the success he has achieved as Director of Naval Education. All who have followed his distinguished career as an engineer, man of science, and educationist, have been certain that his efforts in working out the details of the studies corresponding to the new scheme of naval training would be attended with success, provided that he was allowed a sufficiently free hand in the selection and arrangement of the work. The new scheme came into existence at Christmas, 1902, and in the comparatively short period that has elapsed since that date the whole fabric of naval education has been reconstructed in accordance with the cardinal principles of "common entry" for all cadets, and subsequent "specialisation." The great measures associated with the names of Lord Selborne and Lord Cawdor, energised from within the Navy by Admiral of the Fleet Sir John Fisher, must have demanded an enormous amount of precise thought and accurate proportioning of details regarding the planning of the curriculum, the classes, the laboratories, and the workshops, with their various machines and appliances, for giving us sturdy and bright young officers for the Navy. It is upon Prof. Ewing that the arrangement of these details has largely fallen, and now that his work is sufficiently complete to be comprehended as a whole, and on a proper basis, he has rendered an account of it which ought to dispel the last traces of doubt from those who have entertained misgivings as to its meaning, and as to the benefit it will confer upon the naval organisation of the Empire. His lecture at the Royal Naval College, Portsmouth, on May 11th, delivered before an audience of naval officers, deals with most of the points which have been the subject of criticism. It is impossible here to review those points, but it is in the highest degree satisfactory to us to know that Prof. Ewing, in whose judgment we have confidence, and whose discretion and discernment in these matters are acknowledged throughout the whole engineering profession, is able to assure us that, "much as the scheme has been attacked, the faith has never for a moment been shaken of those whose privilege it has been to take part in working out its details, and who, whatever may be said in disparagement of their judgment, have at least the advantage of an intimate knowledge of its intention and character."

So far as we have followed the controversy to which Prof. Ewing alludes, it has always manifested itself to us that the question in dispute arose from misconception on the part of the assailants of the scheme in respect to matters of fact upon which they had not adequately informed themselves. The lecture of Prof. Ewing, which was published in full in the *Times* of Saturday, May 12th, is in some sense an official

statement, and as it is characteristically lucid and comprehensive, it should go far to dispel any lingering objections to a scheme which is destined to co-ordinate the resources of the Empire with the requirements of the Navy on a logical and progressive plan. He tells us in effect that the scheme, when fulfilled, will make every officer available as a fighting unit in the completest measure, that it will give every officer that practical knowledge of mechanism which the character of ships and the conditions of warfare render indispensable, and that under it the Navy will be, more than in the past, "one in sentiment, one in tradition, and one in aspiration."

If our readers desire to examine the evidence upon which the more recent features of the developed scheme are established, they can do so by consulting the Reports, published as a Blue Book last Friday, of the Departmental Committees appointed by the Admiralty to consider various questions concerning the extension of this reform. This Committee, which was presided over by Vice-Admiral Sir H. Douglas, consisted of Prof. Ewing, Captain Slade (who is the Captain of the Royal Naval College), Captain Bacon (one of the most brilliant officers in the Navy), Captain Oliver, Mr. Graham Greene and the Chaplain of the Fleet. They took evidence from three admirals, two captains, three commanders, one lieutenant, three engineer rear-admirals, one engineer commander, besides naval instructors and others, throwing light upon every phase of the recent controversy. Their report and evidence are convincing testimony of the wisdom of the reform and of the thoroughness with which every aspect of the question has been examined by the responsible representatives of the British people in matters naval—the Board of Admiralty. Lastly, the scheme finds indirect support from the instructive report recently published by a Committee of the Institution of Civil Engineers, who were appointed to advise as to the best method of educating and training engineers. A summary of the report appears elsewhere in this issue. This Committee restrict their observations to the training of civilians, but in substance they recommend a system which, as regards school work and training, runs in many respects on parallel lines with the Admiralty scheme, and our readers who are interested in these matters will find their time well spent in comparing the results and evidence provided by these three documents.

THE LOCAL GOVERNMENT BOARD AS GUARDIAN OF THE RATEPAYERS.

The inquiry into a further loan of £62,000 for the electricity undertaking of the West Ham Corporation, which opened on the 24th ult., and was adjourned *sine die*, throws considerable light upon the policy of municipal trading.

When the present Government came into power, and the Local Government Board was placed under the presidency of the Right Honourable gentleman known as "Honest John Burns," it was feared that municipal trading would run riot; but at the West Ham inquiry, after the drastic action of the Inspector, it is strange to read the remark of one of those taking part in the proceedings, who exclaimed, "I take it, it is through John Burns that this is all happening."

And now let us see what has happened, and apply the facts to our constant condemnation of incompetent municipal trading in electricity supply.

Here is a concrete case of the attempt to carry on a highly technical business of which the Corporation as a body has no knowledge, and entirely on borrowed capital.

The Inspector asked for a good deal of information, some of which was forthcoming before the inquiry adjourned, and probably the local authorities were surprised to find that the department he represented possessed and intended to bring home to them facts of a very inconvenient nature. The questions raised are most serious, and point to the absolute necessity for a strict Government audit of electricity accounts.

The Inspector wanted to know "the net loss for the five or six months' working up to March 31st, 1899, and for each succeeding year," and the borough treasurer presented the following figures:—To March, 1899 (three months' supply), net deficiency, £1,124 5s. 11d.; year ending March, 1900, net profit, £196 1s. 1d.; March, 1901, net deficiency, £2,491 19s. 1d.; March, 1902, net profit, £1,125 4s. 11d.; March, 1903, net profit, £1,624 6s. 4d.; March, 1904, net deficiency, £3,788 6s. 10d.; March, 1905, net deficiency, £744 10s. The total result was a net deficiency to March last year of £5,206 9s. 6d.

The discussion upon these figures led to some interesting facts, the Inspector pointing out that of the net deficiency £7,200 had been charged to the rates, and inquiring: "*Where is the depreciation fund? Is there any?*"

The borough treasurer, in reply, trotted out the old fallacy, viz., "The fund set aside for the repayment of the debt was 3·47 per cent.; this was equivalent to depreciation provided for in a business undertaking." We are not surprised to find that this was met by the expressive term, "Nonsense," from one of the audience.

No one expects to find an electric supply undertaking profitable for two or three years after its initiation; but the curious aspect of the figures connected with West Ham is that a profit was claimed for the first year, no doubt causing much rejoicing, but followed by a large deficiency in the next year, which probably made many a councillor tremble for his seat at the next election, but which was put right the next year by a profit not long sustained. For the fifth year a bigger deficiency than any was shown.

Not only has the trading been unremunerative, but this is in spite of the supply to an extensive tramway undertaking, which would in ordinary course add to the profits by an improved load factor.

In an inquiring spirit, but not necessarily to oppose, the Forest Gate Ratepayers' Association attended, their representative, Mr. Marcus Cohen, eliciting some most valuable information as to the proceedings of the Corporation. It would be very much to the advantage of the public if ratepayers' associations existed in every town to watch over their interests, instead of being, as they too generally are, mere committees for electioneering purposes.

Among the astonishing facts brought out was this: *loans were asked for to pay for plant for which money had already been borrowed.* The electrical engineer pleaded that the matter was urgent, as they wanted to use the machinery; and he was reminded by the Inspector that "sanction was given three and a quarter years ago." The poor engineer is to be

pitied, for he had been in office for about six months only, and could give no information as to how the money had been spent. No wonder that Mr. Cohen exclaimed, "The whole thing seems in a muddle," and it is satisfactory to find that the Local Government Board promise, through their Inspector, to get "the whole thing straightened out before we have finished."

It would be a very useful course if a Commission of Inquiry were held into the accounts of municipalities generally, with a view to ascertaining how the trading in electricity supply has resulted, and if it were promoted by the present President of the Local Government Board it could not be said that his bias was against the principle of municipal trading.

The case of West Ham is a typical one, and a strong light is thrown upon the practical difficulties attending the management of such a business by a body of elected representatives, who delegate to a Committee the position which in a private undertaking would devolve upon the heads of the firm or a responsible body of expert directors. We see how the engineer at West Ham requires machinery to enable him to supply his customers, and how powerless he is in the hands of Committees who are unable to give him what he needs, but who, as Mr. Cohen observed, are capable of getting the whole thing muddled.

The position of West Ham is a very serious one. The rates amount to 10s. 8d., or 11s. if money taken out of the reserves (which has been paid by the ratepayers) is taken into the account, and it is obvious that local industries must be seriously hampered by such a charge, and if they remove to other places, the condition of the town must be further impoverished by a reduction in the rateable value upon which the rates are payable and a decrease in the openings for employment.

The total indebtedness of West Ham was stated to be £3,018,000, of which £798,657 was for education. The debt on the electricity undertaking was £310,844, and according to the accounts for 1905, the total capital expenditure was £318,273, but in the evidence before the Inspector, it transpired that there had been an excess of expenditure over the authorised amount of borrowings sanctioned, of £26,000.

The following questions and answers speak for themselves :—

The Inspector : Have you received the money for this machine in respect of which you are now applying for a loan ?

Mr. Seabrook (the electrical engineer) : I take it we have, as we have exceeded the total amount of the original loan.

The Inspector : Quite so, and we must know how that money has been expended before we sanction a loan twice over !

The Deputy Town Clerk : This is the first time I have seen it.

The Electrical Engineer : And it is the first time I have ! A fine specimen this of municipal trading !

Municipal Telephone Finance.

THE Local Government Board inquiry into the application of the Swansea Town Council for sanction to a loan of £7,000 to extend the municipal telephone system brought to light some interesting figures bearing on the hopeless financial condition into which unreliable plans and estimates and uncommercial rates have led the municipal telephone concerns. The inquiry was suddenly adjourned after a short hearing, as the Inspector discovered that the larger part of the loan applied for had already been spent, and much of it on work of a different character from that described in the application and shown on the plans. The Town Clerk was as much surprised at this discovery as the Inspector was annoyed, and asked for the inquiry to be adjourned so that a fresh application might be prepared. No comments on the class of business management thus revealed were made, and they really seem to be superfluous. We are getting accustomed to finding that whenever any real inquiry is made into municipal management of technical businesses the most deplorable state of muddle and confusion is revealed.

Apart from once more demonstrating this slipshod style of administration, the Swansea telephone inquiry showed clearly that municipal telephones are operated at a heavy loss. The total capital cost of the Swansea system is £27,172. Applying the usual discount to the usual inflated statistics, there are 902 direct exchange lines, giving an average capital cost per line of over £30, as against the estimated £20. The accounts show a paper "profit" of £534, but they also show a large capital expenditure during the year, considering the small growth of the business, and such trifling charges for working expenses as would lead one to suppose that in Swansea telephone lines, switchboards and instruments maintain themselves automatically. No allowance for depreciation has been made, though much of the plant—three years old—is admittedly obsolete, and the Postmaster-General, after an expert valuation, has offered for the entire system £10,000 less than its book cost. Presumably the Swansea Town Council, and some others in the same boat, think that the Postmaster-General and his technical advisers do not know their business, but the reasonable probabilities are that the telephone business is better understood at St. Martin's-le-Grand than in any town hall in the country. The municipal telephone systems are clearly living on their capital, and working at a heavy annual loss ; we have always contended that this was the only deduction to be drawn from the various municipal telephone accounts. The terms offered by the Post Office for the purchase of the various systems—terms based on an expert examination and valuation of the plants, and showing that depreciation must be reckoned with on a liberal scale—prove the correctness of our contention. It remains to be seen how long the municipalities will persist in throwing good money after bad.

Car-Wiring.

"THE protection of cars against fires includes the covering of exposed parts of the under-framing with fireproof material, the housing of straight runs of cables in fireproof lined boxes and in circular 'loom' at entering and leaving points, and the prevention of accumulations of dirt, dirt being considered one of the most frequent causes of fires on cars." Thus the conclusion of an article in the *Street Railway Journal* for April, describing, with drawings, how the Washington cars are wired.

Neither Washington nor any other American city can teach us any more than we know already about wiring electric trains for safety and convenience, (much of that knowledge having been derived from that great continent), but we can take a few hints from Washington about tramcars without loss of dignity. The only one we will mention relates to the exclusion of dirt, and we shall have the sympathy of managers who know how full of sand, and tickets, and dust, and rubbish the space under the seats becomes, and how difficult and costly it is to keep it tidy and clean.

The cure for all this trouble, expense, and actual danger is to omit seat risers from the design, leaving a clear space the whole width of the car below seat level. The space can be clear in name only if the present and often unavoidable practice of placing cables, sand-boxes, rheostats, and even lightning arresters beneath the seats is continued, but the alteration will provide the opportunity for carrying out the wiring decently in neat fire-proof casing ; for housing the sand boxes so that tickets do not drop in and sand does not fall out ; and for treating the rheostats with respect and due regard for ventilation.

Once remove the risers or "kicking panels," as they have been named, not inappropriately, and tidiness will arrive automatically.

It is not necessary to keep the alteration for future cars for at small initial expense, which will be out-weighed by the accruing advantages, existing cars can be so treated.

D

WIRELESS TELEGRAPHY.

By REGINALD A. FESSENDEN.

(*Concluded from page* 746.)

Notes on Commercial Wireless Telegraphy.

My attention has been called to the editorial on wireless telegraphy on the River Amazon in the issue of your esteemed paper of February 2nd. I am free to admit that to a certain extent the criticisms there made are just. It is true that reports on wireless telegraphy have not been as full as they might otherwise have been.

With reference to the above-mentioned Amazonas stations, the following may be of interest :—

The stations referred to are more than 100 miles apart. The latest edition of Stieler's Atlas gives the stations as more than 150 land miles apart. The cable between Para and Breves, whose course does not differ very greatly in length from a straight line, is, I understand, about 140 sea miles, or about 160 land miles, and Pinheiro is about 5 or 10 miles out of Para on the far side, so that the distances check up approximately. The delay in getting the stations in operation was due to the fact that the stations, as sent down, were only guaranteed for a distance of 100 miles, and when it was found that the distance was really more than 150 miles, some changes in construction were necessary.

These stations worked, as reported, perfectly satisfactorily at all hours of the day and night for two weeks without any interruption. After this test, as stated in your issue of February 2nd, it was decided to move the Pinheiro station directly into Para.

The decision of the Brazilian courts then put a stop to operations.

One of the chief reasons for the unsatisfactory working of wireless stations has been the pushing of the stations beyond their real capacity, and giving as the range of working the distance over which the stations could work under the most favourable conditions. This is much as if one were to take as the distance over which a quadruplex would work, the distance over which it could work in perfectly dry weather and with all the lines perfectly insulated.

The only fair standard is the distance over which the wireless station will work under any condition of weather, and this is always considerably less than that over which the station will work under the most favourable circumstances.

For example, the stations above referred to, which were sent down to the River Amazon, had worked over a distance of 600 miles under favourable circumstances in America, but our company only guaranteed them for 100 miles.

In fact, much longer distances have been worked over with the same apparatus. As an illustration, messages have been exchanged between two stations equipped with our apparatus, more than 1,000 miles apart, one of the stations being the lightship off Cape Hatteras, having a mast only 75 ft. high and equipped with a ¼-H.P. spark transformer, the other being a Government station equipped with a mast 175 ft. high, and a 2-KW. outfit, in the West Indies. Messages were transmitted both ways, the distance being 1,029 miles. Under favourable circumstances in daytime, with masts 135 ft. high, messages have without difficulty been transmitted, with an expenditure of energy of 5 watts, over a distance of 100 (one hundred) miles. It would be absurd, however, to put stations on the market working so near their limit, and yet this is what has been done continually and is one of the things that have thrown wireless so much into disrepute.

With an expenditure of less than ½ H.P., there is no trouble whatever in working day and night over a distance of 100 miles through severe electrical storms and interference. Many tests have been made of this, and as many as 600 messages have been sent in a day of 10 hours between two stations 100 miles apart with masts 135 ft. high and using less than ½ H.P. of energy. The messages in this test were so-called 10-word messages, each containing with address, signature and operators' information about 25 words.

This, it is true, is only an average of 25 words per minute, but the speed is only limited by the ability of the operator to receive, and Morse messages have been sent at a speed of more than 35 words per minute, and on one occasion, with operators furnished by the U.S. Signal Corps, a speed of 65 words per minute was obtained, using Phillips code. There is no difficulty in the mechanical transmission and receipt of wireless messages at high speed, and I have no doubt that there is, at least, one other company, in addition to our own, which is ready at present to take contracts up to speeds of 250 words per minute.

Transmission by wireless is, as a rule, more reliable than transmission by wire lines, and on no less than three occasions during the past three or four years our company has offered to handle the business of the Western Union and Postal Telegraph lines. The last occasion was in December, 1904, when all telephone and telegraph lines between New York and Philadelphia and Washington were down and our wireless lines were the only ones working.

Commercial Wireless Working.

The fact that wireless stations are not being installed for commercial working all over the world has nothing to do with the wireless apparatus itself, but is due solely to the action of the different Governments, who have uniformly refused to permit the operation of wireless stations. These countries it will be noted have no hesitation in accepting fees for patents on wireless telegraphy, but refuse to permit the operation of the patents after the fees are paid. This fact is not generally understood, and so I will deal with the subject specifically.

Our own company (the National Electric Signalling Co.) has ever since 1902 been endeavouring to obtain permits to erect wireless stations for commercial work, but up to date without success in a single instance. The following are some of the applications made and the results :—

1. *Application to Work from Bermuda to New York.*—This application was filed in 1902. Most of the trade of Bermuda is with New York, and there is no direct communication. Petitions were signed by most of the merchants and large planters in Bermuda and the New York Produce Exchange signed a petition and sent it to the U.S. Secretary of State, asking him to get the American Ambassador in London to use his influence in the matter. After the lapse of several years the permit was refused, although the precaution had been taken of forming a company largely from Bermudians. Representatives were twice sent to England, once on behalf of our company and once on behalf of the Bermudan stockholders, to see if the permit could be obtained, but without success.

2. *Application to Work between Cuba and the United States.*—After more than a year's work the only permit that could be obtained here was one according to which the rates would be fixed by the Cuban Government *after* the stations had been erected and no permit given to even transmit the messages from the company's station into the city of Havana, and the taxes, &c., were to be fixed later.

3. *Amazonas Working.*—The result of this is given in your editorial of February 2nd. After the stations were up and working, permission to proceed to operate them commercially was refused.

4. *Application to place Station on Sable Island to report Ships.*—Three years were spent in trying to get this permit, but without success. A Canadian company was formed which has been trying for a year and a half to get the permit, also without success.

5. *Newfoundland.*—About three years has been spent in attempting to get a permit to erect stations on Newfoundland. About four months ago we were definitely informed that no permit would be given, as an exclusive permit had been given to the Marconi Co.

6. *French Permit.*—Attempts have been made at various times during the past two years to obtain a permit to work between France and the United States. Up to date this permit had not been granted, though the company still has some hopes of obtaining it.

7. *Permit to Work between Spain and the United States.*—The same remarks apply to this permit as to the permit to work with France.

In addition to the above, it has been attempted to obtain permits to work in India, New Zealand, Australia, Mexico,

Germany, British Guiana and other places, but so far without any success.

England and the United States are the only places in which it has been found possible to put up wireless stations. In England about two years were spent in trying to obtain a permit, and finally a permit was obtained to erect an experimental station at Machrihanish, Scotland; it is hoped that as soon as the possibility of working across the Atlantic commercially is demonstrated, a permit for commercial working will be granted.

The question may be asked, Why go abroad to establish commercial stations? The answer to this is that it is only in working across seas that wireless telegraphy can hope for an *immediate* return without the expenditure of several millions of capital.

As an illustration of this, our company, after making extensive tests for over a year between New York, Philadelphia and Washington, decided to enter into competition with the landlines between those points, on the ground that we could give a more reliable and better service.

It was found, however, that after paying for messenger service to collect and distribute the messages, even if the wireless telegraph took half the business between those points, the profit, while sufficiently large for a single operating company, would be small in comparison with the profits to be made by working over seas. It was for this reason it was decided to commence commercial work in competition with cable companies rather than with landlines.

In addition, the various governments have interfered in other ways and seriously checked the development of wireless working. As an illustration of which I can speak personally, our company had negotiations under way with various steamboat lines comprising nearly 200 vessels, and the contracts were nearly closed, when the United States Government published a statement to the effect that it was proposed to make wireless telegraphy a Government monopoly and to transmit all messages free, on the ground that it was not possible for stations to work without interfering with each other. This statement was not, of course, true, our Washington station, for example, working regularly with our Boston station, 400 miles away, day and night, in spite of the fact that the U.S. Navy station at Washington is only 1¼ miles from our Washington station; and a demonstration of the fact that it *is* possible to cut out interference resulted in a failure of the attempt to make wireless telegraphy a Government monopoly. But it nevertheless put an end entirely to all prospect of doing business with shipowners, and it is only lately that they have begun to consider the matter again.

Altogether, our own company has spent nearly $100,000 in attempts to obtain permits to work wirelessly, but up to date without success.

Still another difficulty in commercial wireless working has been the fact that a number of Governments have equipped their departments with wireless apparatus made by themselves, in spite of the grant of patents. To take a specific instance, the U.S. Navy has installed more than 100 liquid barretter receivers without paying the owners of the patent a single cent. in spite of the fact that the ownership of the liquid barretter has been decided not less than four times by the Courts. There is, as a rule, no legal resource against such acts on the part of Government departments, and all that can be done is to hope for officials with a higher standard of morality. The average Government official, for some reason or other, does not consider a patent as property, and the same individual who would hesitate to buy 50 chronometers which he knew to be stolen has no hesitation whatever in installing 50 breach mechanisms or 50 wireless receivers whose ownership has been decided by the Courts again and again.

It is only fair to say that, as a rule, the permanent Government officials are not responsible, but are overruled by those higher up in authority, and, curiously enough, those department heads who are of the legal profession have, as a rule, shown the least respect for property rights.

All this makes it rather hard for the wireless companies. Our own company had spent, on making up the accounts some four or five months ago, the sum of $422,000 in experimental work, and had received something like $20,000 from the sale of apparatus.

It will be seen that the present prospects of wireless telegraphy are not very bright.

[The following letter, received on Monday last, is of interest in this connection.—Eds. E.R.]

Liquid Barretter Litigation.

As the present status of the litigation on the liquid barretter patent has been greatly misrepresented, we would be greatly obliged if you would kindly give publicity to the following statement of the facts in the case. The following decisions have been rendered:—

(1) October 16th, 1905.—National Electric Signalling Co. *v.* De Forest Wireless Telegraph Co., A. White, L. De Forest, *et al.* Decision in favour of the National Electric Signalling Co., holding that De Forest Co. infringes patent, and ordering an accounting for damages.

(2) November 8th, 1905.—National Electric Signalling Co. *v.* De Forest Wireless Telegraph Co., A. White, L. De Forest *et al.* A decree of injunction against De Forest Co., A. White, L. De Forest and the officials of the De Forest Co., restraining them from using, manufacturing or selling the liquid barretter.

(3) January 27th, 1905.—National Electric Signalling Co. *v.* Gesellschaft fur Drahtlose Telegraphie, m.b.H. *et al.* Decree of injunction against Slaby-Arco or Telefunken Co., restraining them from the use of the liquid barretter in any of its forms.

(4) De Forest Wireless Telegraph Co. *v.* National Electric Signalling Co. Charging the National Electric Signalling Co. with infringement of the Neugschwender-Schaefer-De Forest "Goo" receiver. Suit dismissed.

(5) April 7th, 1906.—National Electric Signalling Co. *v.* De Forest Wireless Telegraph Co., A. White, L. De Forest *et al.* Decision in favour of the National Electric Signalling Co. to the effect that the "Spade" electrode used by the De Forest Co. infringed the National Electric Signalling Co.'s liquid barretter patent, enjoining the De Forest Co. against further use of this type of receiver, and ordering an accounting for damages.

(6) May 1st, 1906.—National Electric Signalling Co. *v.* De Forest Wireless Telegraph Co., A. White, L. De Forest *et al.* Motion brought for contempt of court. White, De Forest and De Forest Co. adjudged guilty of contempt of court, and arrest ordered and bail fixed at $10,000.00.

We are, very respectfully,

National Electric Signalling Co.,
Reginald A. Fessenden.

Western Tower,
Brant Rock, Mass.,
May 2nd, 1906.

THE EDUCATION AND TRAINING OF ENGINEERS.

We have before us the "Report of a Committee appointed by the Council of the Institution of Civil Engineers" on the Education of Engineers.

This Committee was appointed late in the year 1903 to make a thorough investigation into the best method and means of educating the average youth who desired to make engineering his profession. The Committee's report has recently been issued; we give a brief summary of it below.

The sections which the Committee proposed for inquiry were:—

1. Preparatory education in secondary schools.
2. Training in offices, workshops, factories, or on works.
3. Training in universities and higher technical institutions.
4. Post-graduate work.

With these objects in view, the Committee has made the following recommendations:—

I.—Recommendations in Respect of Preparatory Education.

1. It is desirable that a boy intended for the engineering profession should, before leaving school and commencing to specialise, have attained a standard of education equivalent to that required by the Institution Studentship Examinations; and that he should not commence his special training until he is about 17 years of age.

2. A leaving examination for secondary schools, similar in character to those already existing in Scotland and in Wales, is desirable throughout the United Kingdom. It is desirable to have a standard such that it could be accepted by the Institution as equivalent to the Studentship Examination, and by the universities and colleges as equivalent to a matriculation examination.

3. Advanced teaching of history and geography, with instruction

and practice in essay-writing and in précis-writing, should be included in the ordinary school curriculum; and the instruction in English subjects should include at least an introduction to English literature.

4. Greek should not be required, but an elementary knowledge of Latin is desirable. Modern languages, especially French and German, should be studied, and should be taught colloquially or in such a way as to give the pupils a practical knowledge of each language, sufficient to enable them to study its literature and to converse in it with some degree of facility.

5. Instruction in mathematics should be given by methods differing considerably from those usually adopted in the teaching of this subject merely as an intellectual exercise. The geometrical side of mathematics should be fostered, and before they leave school boys should be conversant with the use of logarithms, and with at least the elements of trigonometry, including the solution of triangles. It is also of importance that instruction in practical arithmetic should be carried further than has been generally the case hitherto, with the object especially of encouraging the use of contracted methods and operations in mental arithmetic; and of encouraging also the expression of results with only such a degree of (numerical) precision as is consistent with the known degree of certainty of the data on which they are or may be supposed to be based.

6. It is preferable that boys should attain at school a general knowledge of elementary physics and chemistry, or of what is sometimes called "Natural Philosophy," rather than that they should pursue in detail some particular department of science.

7. Special attention should be given to drawing; the instruction should include ordinary geometrical drawing with orthographic projection, curve-drawing, freehand drawing and practical mensuration.

8. Work in the nature of handicraft, such as carpentry or turning, or elementary field-surveying, may be encouraged as a recreation but should not be required as a school exercise.

The Committee recommend that this scheme of preparatory education should be officially communicated to the Board of Education and widely circulated amongst those engaged in the conduct of secondary schools and engineering colleges, in order that future schemes of tuition of youths who contemplate entry into the engineering profession may be guided thereby. The Committee are of opinion that if this course were taken it would assist in overcoming one great difficulty now universally felt in institutions in which applied science is taught. At present a considerable proportion of students enter technical institutions ill-prepared, and at least one year has to be devoted to instruction which ought to be secured beforehand. Proper preparation is essential if students are to derive full benefit from special instruction in applied science. Professors and teachers ought not to be required to undertake subjects that should be taught elsewhere, but should be left free to devote themselves to scientific and technical instruction, which is their real work.

The gentlemen whose opinions were asked were actively engaged in professional work, and in consequence there were delays in making replies. From the replies received it is obvious that the tentative suggestions and recommendations embodied by the Committee in their schedule have received very general support; this support has been given by each of the great sections of the engineering profession. A few correspondents expressed radically different views; but, in the main, the opinions of the Committee have been endorsed, and this result is satisfactory, since it indicates the possibility of practical effect being given to the recommendations.

The Committee have had in view throughout what may be termed an "average boy," of ordinary ability, whose parents are in a position to secure for him a thorough training before he begins his actual professional work as an engineer. They recognise the necessity that will always exist for providing also suitable means of training for young men not so favourably situated, who work their way by sheer ability and force of character, and whose earlier careers do not permit of the methodic preparatory education and training which they consider best for the average boy. Their concern therefore has been with the best general scheme adapted to the average boy.

II.—Inquiry as to Engineering Training.

The Committee found it convenient to deal with Sections 2, 3 and 4 of the inquiry together. In these instances also a schedule of questions was framed, and was circulated widely. Perfectly independent statements of opinion were submitted in many cases. The Committee desired primarily to ascertain the views of men whose opinions were entitled to respectful consideration, in consequence of their experience and study of education and of engineering training. In all instances these communications have received due consideration by the Committee, after being carefully grouped and analysed.

Recommendations in Respect of Engineering Training.

The Committee desire to preface these recommendations by the statement that they are unanimous in the opinion that engineering training must include several years of practical work, as well as a proper academic training. Long experience has led to general agreement amongst engineers as to the general lines on which practical training should proceed; and it has, therefore, been unnecessary to deal at any great length with that matter in the recommendations.

Taking everything into account, the Committee make the following recommendations:—

1. The average boy should leave school when he is about 17 years of age.

2. The practical training should be divided into two parts, whenever that arrangement can be made; and the preliminary stage of practical training should consist in all cases of at least a year spent in mechanical engineering workshops. This "introductory workshop course" is desirable even when students do not contemplate devoting themselves at a later stage to what is generally designated "mechanical engineering." In some cases it may be preferred to take the workshop course after the first year of the college training common to all branches of engineering. An interruption of college training at a later period must involve great disadvantages.

3. During workshop training boys should keep the regular working hours, should be treated like ordinary apprentices, be subject to discipline and be paid wages.

4. Nothing should be done in the form of evening study which would impose undue strain upon the physique of boys. In some cases this might prevent attendance at evening classes; but experience shows that many boys can attend such classes without physical injury and with great educational advantage. The Committee think it is most important that all boys *should at least maintain their scholastic acquirements during the introductory workshop course*, and, for the class of boys in question, it is considered that this result might be secured, by private tuition or otherwise, without undue physical strain.

5. As a rule, it is preferable to proceed to a technical college or university on the completion of the introductory workshop course.

In some cases—as, for example, when boys are intended to become mechanical engineers—it may be advantageous to complete the practical training before entering college; but, if this is done, it becomes more important that simultaneous education during practical training should be secured by private tuition or in evening classes; otherwise boys would lose seriously during four or five years' suspension of systematic study, and would be disadvantaged on entering college.

6. For the average student the period of college study should be three sessions, provided he is well prepared before entering college. In the case of students who desire to follow up the science of their profession a fourth year might be added, which would be in some cases post-graduate work, and might come after the practical training was completed. In cases where students are exceptionally well prepared before entering college, or are above the ordinary age, or possibly without the means required for a full course of study, facilities should be given for shortening the course of study.

In all cases the first session might be advantageously devoted to a common course of study by average students, and probably that common course might be extended into the second session without loss to final specialisation.

7. A sound and extensive knowledge of mathematics is necessary in all branches of engineering, although some of these branches require more advanced mathematics in their practice than others. The capacity for acquiring mathematical knowledge varies greatly in individual students, and many who become competent engineers have not the power of acquiring the higher mathematics.

The Committee endorse the practically universal recommendation, made by those whose special knowledge and experience entitle them to speak with authority, that a sufficient time should be allotted to the study of pure mathematics during the common college course, to permit the best students to obtain a sound knowledge of algebra, trigonometry, analytical and practical plane geometry, the elements of solid geometry, and a working knowledge of the differential and integral calculus, and of the simpler differential equations. To this fundamental mathematical training there must be added instruction in applied mathematics and mechanics.

In the latter terms of the college course of study, time devoted to purely mathematical instruction should be lessened as compared with the time similarly devoted during the earlier terms; and that given to specialised instruction in engineering subjects should be increased. The most advantageous arrangement, both for students and teachers, will consist in the combination of mathematical and engineering instruction by the professors and teachers of engineering. The teachers of pure mathematics also, in dealing with the students during their common course of study, should be well informed as to the applications of mathematics in engineering, so that their courses of instruction may be arranged suitably, and that departments of these subjects having no bearing upon engineering may not have given to them unnecessary time or attention.

8. At least three to four years should be spent in practical training, inclusive of the "introductory workshop course" previously mentioned. The Committee favour a total period of four years' practical training where it can be secured, this being carried out in workshops, on works, in mines and in offices, as may be required in each case. It is highly desirable that a part of this practical training should be obtained in drawing offices.

9. Where college training is completed before practical training is taken, the total period devoted to the latter should be three years in ordinary cases. The hours of work should be the same as if the usual course were followed; the wages paid should be somewhat higher, especially in the later years.

10. The Committee recommend strongly efficient instruction in engineering drawing.

Instruction in testing materials and structures, and in the principles underlying metallurgical processes and other practical operations incidental to the branch of engineering in which a student proposes to specialise, should be included in the college course.

In regard to workshop practice in technical colleges, they are of opinion that boys who have spent one or two years in mechanical

engineering workshops should not be instructed in workshop practice at technical colleges.

11. In connection with the grant of degrees, diplomas and certificates to engineering students, considerable importance should be attached to laboratory and experimental work performed by individual students, as well as to their progress in mathematical and scientific studies; *and degrees, &c., should not be granted on the results of terminal or final examinations alone.*

12. Facilities for, and organisation of, post-graduate work by engineering students in universities and higher technical institutions should be considerably increased. This recommendation is made with the special object of encouraging qualified students to undertake researches which may prove of practical value to engineering operations and processes. In many cases the best period for post-graduate work would be that following the completion of practical training, even when that training follows the college course.

13. The Committee reaffirm the conviction expressed when they issued their inquiry, that the sympathetic assistance of employers is essential to improvement in engineering education and training.

Undoubtedly, the scheme is good, if it can be carried into effect. It is to be seriously noted, however, that the complete course extends over from six to eight years, and it is questionable whether any large percentage of our engineering students can by any means afford so long a time in preparation to earn their living. Surely the recommendations presuppose an unlimited purse on the part of the parents? Or do they suggest an extravagant list of scholarships from some public fund, such as is at the disposal of the Chancellor of the Exchequer?

Assuming, however, that the means are forthcoming, the system of training advocated by the Committee is admirably adapted to the end in view. We would draw special attention to the emphasis laid upon the importance of mathematical knowledge in all branches of engineering; that not all are possessed of inborn mathematical genius is, alas! too true; but there are few who, *if properly taught*, could not readily acquire a working acquaintance with this invaluable tool. That no training is complete without a thorough knowledge of at least one foreign language, as well as of the mother tongue (too often sadly neglected) is no less true. We note with satisfaction, too, that one year's practical training in engineering workshops is recommended for all classes of engineers. The fundamental elements of an engineer's equipment are obedience to discipline, willingness to work and the ability to "use his hands."

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

American Correspondents Please Note.

We receive so many queries from the United States with, in almost every instance, postage underpaid thereon, that we have decided entirely to disregard such correspondence.—Eds. Elec. Rev.

Elementary Electrical Engineering—A Review.

I trust you will accord me the favour of making a few remarks on the subject of the review of the above work, on the ground that I have been (1) a contributor and correspondent of this journal, (2) that I am a member of the teaching staff of a technical college whose certificates are esteemed throughout Lancashire and the North generally, and (3) that the work reviewed has been for some time past a text-book in several mining and technical colleges and schools.

It is now about 15 months since the work was sent to you in common with all the British and several of the most influential American engineering journals and magazines with a request for a review. In nearly every case the work was favourably reviewed, and I am indebted to the courteous criticism of many of my reviewers for much information and advice. Your adverse criticism, appearing at the moment when the second edition is being prepared for the Press, cannot but bring about some measure of confusion, especially when the literal errors—almost inseparable from a first edition—are being corrected.

Throughout his notice your reviewer has only been able to point out *one* inaccuracy. It is in the definition of the ampere. It is, through an error of the Press, referred to as quantity of current instead of current strength. This latter meaning is given to it throughout the work, so that there can be no doubt as to how the error originated. The author, at the time the final proofs were being passed, was confined to his bed for nearly two months, and was consequently unable to assist materially in the work of revision. On this error, and two more (not noted by your reviewer) being discovered, an early opportunity was taken to insert an *errata* slip calling attention to them. These were the use of the mathematical formula Pb SO^4 for the chemical one Pb SO_4, and D.P. for P.D.

Your reviewer wishes to know what excuse there can be for my definition of the volt. I don't see why any excuse can be needed. It is correct.

Referring to the properties of the electric current, it is stated "that the strength of an electric current is measured by the magnitude of the effects it can produce in a given time." Your reviewer states that no explanation is offered. Let him read the following, which is the paragraph immediately preceding the one quoted :—

"Electric Current.—When electricity is in motion, it is capable of producing certain effects upon adjacent bodies. It can (1) produce a deposition of metals from their chemical solutions; (2) heat the conductor that it flows through; (3) attract or repel a neighbouring current; (4) accumulate as an electric charge that can attract or repel a neighbouring charge; (5) produce in its neighbourhood a magnetic field." Surely this is sufficient at so early a stage (page 3) of an elementary work.

I concur with your reviewer as to the expediency of indicating which plate in fig. 3 is the zinc and which is the copper. Further, his suggestions as to the best manner of dealing with primary batteries and telephones have been given effect to in the coming edition, and these sections and that dealing with wiring systems have been greatly extended.

I cannot see the justice of your reviewer's comment. In dealing with dynamos and motors, the author has not attempted to explain the elementary theory of the subject. We are told that, "contrary to popular opinion, any dynamo can be connected up to run as a motor." Surely the latter statement is so. What is it, then, that your reviewer means?

I am in agreement with your reviewer that much of the subject matter on circuit breakers was written in a manner not suitable for an elementary work. In the coming edition this will be revised.

In conclusion, may I ask why it should be necessary for me to suggest that the Latimer Clark standard cell is not also used for the same purposes as a Leclanché cell? Of course it is, and can be, used for the same purposes, though it is by no means usual to do so. Its principal use is as a standard for purposes of comparison.

P. T. White.

Bradford House, Wigan.

[In an elementary text-book, the definitions of the ampere, the volt, and the ohm, are the most important, and for a printer's error in the definition of an ampere to be classed with the other two mentioned is inexcusable. Had the rest of the book shown that the author was careful and accurate the printer's error would have been assumed. The definition of the strength of an electric current is either too much for "page 3" of this elementary book, or else it is not enough.

With reference to the definition of the volt, the author has not made it at all clear, and the sentence quoted either requires excuse or explanation.

The author may not see the justice of the remarks on dynamos and motors. Any intelligent reader will, however.

The remarks made about the Clark standard cell indicate clearly the style of the book and the ability of the author to write for the instruction of the student.

It is interesting to note that of the whole review the author has taken note of about one-half and is correcting the second edition accordingly. Until, however, he deals

much more carefully with the elements of the subject the book will remain by no means a satisfactory text-book of electrical engineering.—The Reviewer.]

A New Insulating Material.

I notice that the Allgemeine Elektrizitäts Gesellschaft have recently patented an improved insulation for thin wires, in which they deposit successive thin layers of cellulose tetra-acetate on the wire.

Many years ago I thought out and experimented (in a laboratory way) with gelatine as a covering in which various substances were added, with more or less success.

I tried passing bare wire through a hot aqueous bath of gelatine in which a quantity of potassium bichromate had been added. This I did in a subdued light, and then dried the layer, after which I exposed the wire to strong sunlight for many days to render the covering insoluble in hot or cold water.

After washing, I treated it in a bath of the double sulphates of chromium and potassium and well washed.

The insulation thus made was watertight, would stand boiling water, and, I should say, had a fairly high dielectric resistance. I shall be glad of any observations upon this subject.

A. Treyer Evans,
City and Guilds Honour-Man.

Birmingham, *May 12th*, 1906.

Neutralised Repulsion Motor.

As Mr. Cramp has stated in his last letter, this discussion has become somewhat confused owing to the crossing of some of the letters, and I therefore think that it will be well to recapitulate the points I have raised.

1. I failed to understand why Mr. Cramp's motor should be classified as a so-called "repulsion" motor, and suggested that the machine is certainly not of the "induction" type as all "repulsion" motors, but of the "conduction" type, and is really a shunt machine. This point is of comparatively small importance, and may very well be allowed to rest for the moment.

2. My second point referred to the commutation: I could not see how Mr. Cramp's motor could claim any advantage in that respect over any other conduction machine. It is, of course, necessary to compare motors in which the E.M.F. impressed on the armature is of equal magnitude, and it is quite immaterial from the commutation point of view whether the reducing transformer is embodied in the motor

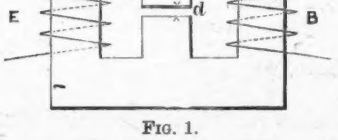


Fig. 1.

itself, as in Mr. Cramp's motor, or is separate from it, as is more usual. As a matter of fact, the commutation of his motor will be worse than that of a good conduction machine, because in Mr. Cramp's motor, motor field and armature current are not in phase.

3. I contended that the weight efficiency of Mr. Cramp's machine must be small, mainly because the energy required for the operation of the motor must be obtained from a coil B, which could only yield a very small output, being disposed in the worst possible inductive relation to that coil E, from which it must derive all its energy by transformer action.

This point has not so far been taken up by Mr. Cramp, but is, I think, of vital importance, and was uppermost in my mind when considering his motor.

4. I further suggested that a large torque was only possible if the armature current O C was greatly out of phase with the E.M.F. O *e* due to B and impressed on the armature, but that under such conditions the power-factor must be bad. This is a further reason for a small output for weight.

5. I claimed that if Mr. Cramp's neutralising coil N could be fully effective, then the E.M.F. O *e* and the current O C would be in phase, the power-factor good but the torque nil.

In his last letter Mr. Cramp rests his deductions on this last hypothesis. Why does he do this instead of explaining to us how his motor really does operate? Surely he must be aware that the neutralising coil N *cannot* be fully effective as far as the circuit is concerned in which it is included. We must rest satisfied if that coil can fully neutralise the self-induction of the armature, it can certainly never neutralise the self-induction of B. That this coil B must have a great self-induction, is evident from a consideration of my third contention.

The object of my fifth contention was to show that if O C is made to coincide with O *e*, in other words, if the power factor of the motor is made high, then the torque will become zero. This contention is, I think, broadly correct, although I am willing to acknowledge that owing principally to the leakage flux, a *small* torque would still be available, even if the armature current O C were really in phase with O *e*. I might also add that in order to make the power-factor unity, it is not sufficient for the O C to be co-phasal with O *e*, it is necessary for O C to lead O *e*.

With the help of his diagrams, Mr. Cramp himself shows that for the case of a high power factor, that is, when O C coincides with O *e*, the torque of his motor is only proportional to part of the leakage flux. Now, it is easy to show that the total leakage field can only form a small part of the total field threading the armature, which total field must be considered as the motor field. Although Mr. Cramp does not seem to think so, yet the greater part of O ϕ passes through the armature from F to F as well as part of the leakage flux. The phase of the resulting motor field consequently approaches the phase of O ϕ_1, and, as can be seen from Mr. Cramp's own diagram, if O C is in phase with O *e*, or leads the latter (*i.e.*, if the power factor is good), then the torque must be small, for O C is then nearly in quadrature with O ϕ_1. This exactly confirms my contentions.

In order to recognise that the leakage flux is small as compared with the transformer flux O ϕ, we must consider my third contention more closely. Looking at fig. 1, it is obvious that as long as the E.M.F. impressed on E is constant, the transformer flux due to E will also be constant. The reluctance of the magnetic circuit may be varied; this variation will vary the value of the no-load current, but not the value of the flux. Suppose the gap *d* to be *nil*, then the transformer flux due to E will divide about equally between the limbs 2 and 3, and a certain E.M.F. (O *e*) will be induced in B. If B is now closed on a given resistance, O *e* will fall almost to *nil*, and very little current indeed will flow through the resistance, be the latter as small as desired, provided only that the limbs 2 and 3 are not saturated. The cause of this is that most of the transformer flux will now pass through limb 2. It is well known that a transformer of this kind will give hardly any output at all, yet Mr. Cramp's motor has to derive all its energy from a transformer forming part of the motor, and designed on this very principle. Of course, Mr. Cramp's motor has an air-gap such as *d* in fig. 1, and the greater this air-gap the more output will it be possible to obtain from B. But even if limb 2 is done away with altogether, we still have but a very poor transformer yielding an insufficient output for weight. Mr. Cramp's arrangement does not, of course, allow of the limb 2 being done away with; in fact, the air-gap is presumably small.

The secondary current will produce a flux in phase with itself, and therefore opposed to the flux produced by the corresponding primary current. Part of these fluxes will link and neutralise each other, the remainder will form the total leakage flux; and what we require to know is, how large is this likely to be, as compared to the transformer flux. It will suffice to consider the two extreme cases.

When the air-gap is *nil*, nearly the whole of the transformer flux will pass through limb 2. The secondary current O C can only be very small, even if the resistance of the armature, the brushes and the neutralising coil be *nil*; the

corresponding primary current will also be small, and although nearly the whole of the leakage flux will pass through limb 2, it will only form a very small part indeed of the total flux through that limb, because the currents to which it is due are only very small.

If the gap *d* is made as great as possible—in other words, if the limb 2 be done away with—then nearly all the transformer flux will pass through limb 3 ; a great proportion of the secondary ampere-turns will, however, now be neutralised by the primary ampere-turns, and there will be comparatively few ampere-turns available for the production of the leakage flux. Notwithstanding this, the leakage flux in the region previously occupied by limb 2 will now form a greater part of the total flux passing that region, but will fail to produce a torque, since, by removing limb 2, the armature has also been removed.

It seems to me a waste of time to say much more. I will, however, add that I am not surprised that Mr. Cramp has obtained a torque from his experimental motor ; but will he tell us what was the *output* of the machine at a given speed, what was its efficiency, its power factor, and its *weight* ? The power factor must have been very bad, or, if it was passable, this could only have been due to a very poor efficiency.

A final point : the back E.M.F. is in phase with the motor field (that field is not ϕ ϕ_1, as Mr. Cramp would have us believe), and leads the E.M.F. (Oe) impressed on the armature by rather more than 90 degrees. As this back E.M.F. increases with the speed, so does the phase of the armature current tend to place itself more nearly in quadrature with the motor field, and the torque drops off with the speed at a very rapid rate.

I am sorry I cannot at all agree with Mr. Cramp ; and I feel sure that if he pursues his experiments he will find that all my contentions are quite correct. It will be impossible to obtain a reasonable output for weight and a good power factor. In fact, I doubt whether the output for weight of his motor will be as great as that of the machine shown in fig. 1 of my letter on April 7th, provided of course that in that motor the winding N is removed.

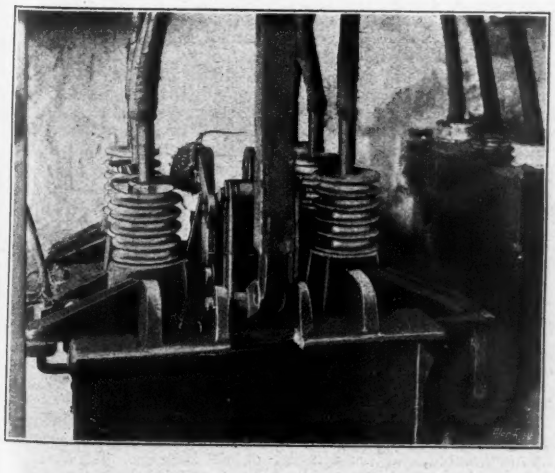
Val. A. Fynn.

London, *May 12th*, 1906.

A Novel Rat-Trap.

I enclose photos which may be of interest to you ; they represent views of the exterior of a 5,000-volt three-phase oil switch in one of our sub-stations.

We had occasion to carry out some minor alterations which necessitated taking the slate panels of the switch-board down, and then saw the three small rats as shown in



Rats Killed by a High-Voltage Discharge.

photo ; they had been electrocuted, and the porcelain insulators broken by the arc. The copper connection and earthed framework showed distinct signs of arcing having taken place. From the condition of the bodies, the "fatality" must have taken place some months previously, although nothing abnormal was noticed on the system.

J. E. Donoghue,
Acting City Electrical Engineer.

Sydney, N.S.W., *April 10th*, 1906.

The Rateability of Electricity Undertakings.

One of the most important matters in connection with the rating of electricity undertakings is the taking into account at all of personal property. The London and Provincial Machinery League was formed with the object of securing legislative reform, which is the only remedy, and among its members are some of the most important electric supply companies. I should be pleased to send any of your readers interested in the employment of machinery, particulars of the league.

The Secretary,
London and Provincial Machinery League.

3, Oxford Court,
Cannon Street, E.C.
May 9th, 1906.

City and Guilds Examinations.

May I draw your attention to the increasing difficulty in the questions which are now set at the City and Guilds examinations in the electrical subjects. What the object may be it is hard to guess, but the result is that students who have worked hard get disheartened, and so give up altogether. This does *not* advance technical education. In the present Honours Paper (Electrical Engineering) a mistake has evidently been made in the title of the Instruments Section, which is entitled "Instruments, &c.," surely from the type of questions set, it should have been "*etc.*" In *two* of the electro-metallurgy papers the statement occurs that "one watt = 0·239 calorie !" That which occurs in an examination paper is usually impressed on the memory, but I am sure every teacher will sincerely wish that such a statement will be immediately forgotten. The error can hardly have crept in through a printer's error, as it occurs in two distinct papers ; perhaps the examiner can explain ?

Plater.

[The error mentioned is quite inexcusable. It is obviously not a printer's error, but even if it were, it would still be unpardonable. It represents that primitive haziness of ideas regarding power and energy against which we are always contending, and which in an examination paper is singularly misplaced.—Eds. E.R.]

Preferential Rates.

We have been interested in the two letters which you have published on this subject. In your issue of March 30th, you quote among successful tenders, Battersea B.C. lamps at 8½d. each. The firm quoting this price is one of the oldest and best known firms, and their price to us, as contractors, works out at a trifle over 10½d. each for a 10,000 lot. Upon calling their attention to the unfairness of this we receiving the following reply :—

"Yours, April 26th. Your favour to hand, and in reply, we beg to state that we reserve to ourselves the right of quoting special prices in competition with these Corporation tenders. *The lamps are not for re-sale*, and, therefore, the matter does not affect the trade."

What does "the trade" think ?

Contractor.

Flexible Wire Dangers.

It has recently come under my notice that a twisted flexible wire (35/40) pendant, supplying current to one 16-C.P. lamp at an E.M.F. of 200 volts alternating, fired owing to the strands on one of the conductors breaking, due to constant swinging, the spark on the break being sufficient to ignite the insulation, which consisted of two layers of vulcanised india-rubber and cotton braiding. The fuse was naturally no protection until a quantity of the insulation had burnt away and the conductors short-circuited. I have since experimented with some other makes of flexible under

similar condition, with the same result. This strongly points to the advisability of fireproof flexibles. One single copper wire of No. 35 gauge shows no appreciable signs of heating with three 16-c.p. lamps in circuit, thus proving that the firing was due to the spark on the breaking of circuit.

Charles J. Hall.

Leeds, *May 15th*, 1906.

OUR LEGAL QUERY COLUMN.

[Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.]

"K" writes:—"The following is an abstract of the provisions relating to meters which are printed in many provisional orders:—

"49. The amount of energy supplied by the undertakers to any ordinary consumer . . . . shall, except as otherwise agreed between such consumer and the undertakers, be ascertained by means of an appropriate meter duly certified under the provisions of this order.

"50. A meter shall be considered to be duly certified under the provisions of this order if it be certified by an electric inspector appointed under this order to be a correct meter, and to be of some construction and pattern, and to have been fixed and to have been connected with the service lines in some manner approved of by the Board of Trade.

"51. Every electric inspector, on being required to do so by the undertakers, or by any consumer, and on payment of the prescribed fee . . . . shall examine any meter intended for ascertaining the value of the supply, and shall certify the same as a certified meter if he considers it entitled to be so certified.

"Counsel has stated that unless the meter is *certified* as prescribed, the electric light accounts cannot be recovered by law. In small towns with a great number of small consumers, it is not possible to carry out this. Where this clause is in force, what is the use of testing meters in central stations, and as the Board of Trade require meters to be "certified," what provision have they made at their testing laboratory for doing so quickly and cheaply?"

*** The difficulty suggested by "K" is one of a practical rather than of a legal nature. It is clear from the form of provisional order in common use that electricity must be measured by a certified meter, and, although we know of no case on the point, it is probable that the Court would only have regard to the register of a certified meter. With regard to the practical difficulty of providing each one of a large number of small consumers with a meter, it is impossible to suggest any remedy. It is understood that the Board of Trade are in a position to test meters quickly and cheaply. A description of their testing laboratories was published in the Electrical Review in October, 1894.

LEGAL.

Marconi *v.* Lloyds.

On the application of Mr. Eve, K.C., on Friday last, Mr. Justice Swinfen Eady consented to hear the above action for Mr. Justice Farwell on May 22nd. Mr. Eve stated that the action was brought on a compromise which had been effected, and the case involved the construction of an agreement and the calling of expert wireless telegraphists from Ireland and other places.

In *re* The Perth Electric Tramways, Ltd. Lyon *v.* The Tramway Syndicate, Ltd.

A special case stated to determine an important question arising in this action came before Mr. Justice Swinfen Eady in the Chancery Division of the High Court on May 10th. The question was whether certain debentures of the Perth Electric Tramways, Ltd., which had been issued, had been put an end to so that they were incapable of being issued again. Of the 21 debentures in question, six had been issued to the defendants, the Tramway Syndicate, Ltd., and the remaining 15 were going to be issued unless the company was restrained by the decision of the Court. The Perth Co. was formed under the Limited Liability Acts, and had issued debenture stock to the amount of £200,000. A further issue of 500 debentures of £100 each was authorised, of which 360 had been issued. In June, 1905, 21 were deposited with the Union Bank of Scotland to secure a loan of £2,000, and the Perth Co. had paid off the loan, received the debentures, and were proposing to re-issue them. Plaintiff, who is a debenture-holder, contended that they were not entitled to do this.

His Lordship held that the plaintiff had a right to restrain the issue of the debentures in question.

The London Electrobus Co., Ltd.

Mr. Eve, K.C., on Friday last, moved before Mr. Justice Swinfen Eady, in the Chancery Division, to rectify the register of the London Electrobus Co., Ltd., by removing the names of several applicants who he said had been induced to apply for shares on a prospectus which was inaccurate and omitted certain material facts.

Mr. Colefax, for the company, said the directors appreciated that some of the statements in the prospectus required qualification and some amplification, and they were getting together the further information which would be embodied in a circular sent to the shareholders, who would be given an opportunity of claiming to withdraw, which would then be acceded to. He thought that should meet the views of the applicants, and if the motion was allowed to stand over for a week, he would give an undertaking not to part with the moneys of the company in the meantime. He said the company had not commenced business, and did not propose to acquire the certificate entitling it to do so until these matters were disposed of. The money was all intact.

His Lordship: But would it remain intact if the company went into liquidation? The applicants would then be unsecured creditors.

Mr. Eve, K.C., for the applicants, said his clients had obtained all the information they wanted without the assistance of the directors, and did not require a week to consider the matter.

Mr. Colefax said he thought it would be better for the motion to stand over until all the shareholders had been circularised.

His Lordship said that it did not matter to the applicants what the other shareholders did. If they wished to leave the company, they were entitled to do so.

Mr. Eve, K.C., said that one of his clients sent in an application form, and next morning, seeing something in the Press, he wrote withdrawing it. He received in the same envelope the allotment form, and a note that it had been sent before his letter of withdrawal had been received.

Mr. Colefax admitted that cases of that kind stood on a different footing.

His Lordship: Unless you can agree, I must dispose of the motion.

Mr. Colefax said that if Mr. Eve persisted he could not resist the order asked for.

His Lordship: The order must go. As regards these applicants, their money must be returned, and the company must pay the costs of the motion.

In the case of Byrne and others *v.* the London Electrobus Co., Ltd., before Mr. Justice Joyce, the plaintiffs accepted an undertaking by the company not to part with any of the money paid by applicants for shares except to shareholders applying on the form sent with the promised circular. The company also undertook not to take proceedings to forfeit shares for non-payment of instalments.

Back *v.* Dick, Kerr & Co.

The House of Lords on Tuesday dismissed the appeal of Wm. Back, a labourer, who, while in the employment of Dick, Kerr and Co., at Exeter, was injured in the act of unloading tram rails in the station yard, some 700 yards from the engineering works then in progress. The County Court Judge held that the accident took place "in, on or about" the engineering works, and awarded the appellant damages, but the Court of Appeal reversed this decision. The Lord Chancellor and Lord James thought the appeal ought to be allowed, and the judgment of the County Court Judge restored, but Lords Davey, Robertson and Atkinson took the opposite view, so the appeal was dismissed.

Crigglestone Coal Co., Ltd.

In the Winding-up Court on Tuesday, Mr. Justice Buckley again had before him the petition of the British Insulated and Helsby Cables, Ltd., for the compulsory winding-up of the Crigglestone Coal Co., Ltd., of Wakefield. The petitioners were creditors for £716 in respect of electric cables.

Mr. Buckmaster, K.C., for the trustees for the first debenture-holders, opposed the petition. He said a receiver and manager had been appointed, and was carrying on the business. The object of the company, which had a capital of £70,000, was to work a colliery, but a fault was discovered, and considerable difficulty arose. He contended that if the property were sold, it would not realise enough to pay more than the first debenture-holders, and that if a winding-up order were made, it would be practically impossible to sell the colliery.

Mr. Justice Buckley, on the last occasion, said he desired to trace who was carrying on the business, and to have it argued whether he was not in a position to use his powers for the purpose of seeing

that the debenture-holders did not sweep into their security assets without payment.

The evidence having been read, COUNSEL for the petitioners submitted that it was clear that for some time the business of the company had belonged not to the company, but practically to the debenture-holders. Since 1903 no dividend had been paid, and no one had received a penny out of the company except the debenture-holders, who were carrying on the business in the name of the company.

Mr. BUCKMASTER, K.C., in reply, said it was not disputed that the misfortune which had ruined this company was a geological accident, which no one could have foreseen—a fault in their colliery which went down 45 yards. In order to get over that difficulty it was essential that they should obtain a temporary advance, which they did by obtaining money by third debentures. It was not suggested that the hope that the company would be able to overcome its difficulties was not well founded. A winding-up order would serve no useful purpose, because there was no dispute that whenever or however the property was sold it could never realise enough to pay the creditors a penny piece. As the petition could not help the creditors, and must inflict still further injury on the debenture-holders, he submitted it should be dismissed.

Mr. Justice BUCKLEY: The debenture-holders say we are going to take £712 worth of electric cables which have been supplied by the petitioners, and we are not going to pay for them. That shocks my conscience.

Mr. BUCKMASTER admitted the hardship on the petitioners, but said they had no legal remedy under the circumstances.

Mr. Justice BUCKLEY: Are you content to return the goods?

Mr. BUCKMASTER did not suppose he could, as he expected they were part of the undertaking. Of course, the consent of the debenture-holders would have to be obtained. The Court had to deal with the fact that the securities held by his clients were allowed by the law. They had done nothing outside the law, and by these proceedings were merely taking advantage of their position under the law.

Mr. Justice BUCKLEY said it did not matter to the company whether he made a winding-up order or not.

Mr. BUCKMASTER agreed, but contended that his clients were entitled to the security the law gave them.

Mr. Justice BUCKLEY said the case was an important one, and he would take time to consider his judgment.

F. A. GLOVER & CO., LTD., *v.* THE DELTA METAL CO., LTD.

THIS case on Tuesday came before Mr. Pollock, one of the official referees of the High Court. Plaintiffs, who carry on business at Clerkenwell, claimed £682 10s. in respect of materials supplied and work and labour done in connection with the installation of electric light for the defendants, at their request, under a contract dated March 7th, 1905, and additions and extras involved. The defence set up was that one of the conditions of the contract provided that payment should be made on the certificate of the engineer up to 50 per cent. of the value of the completed work, and the balance on the engineer certifying that the whole of the works were completed to his satisfaction, provided always that no certificate should relieve the plaintiffs from any liability under the contract. The engineer had never certified that the works were completed to his satisfaction, and defendants contended that the plaintiffs were, therefore, not entitled to recover any part of the balance of the £935 14s. 1d. for work and labour done and materials supplied. With reference to items amounting to £15 11s. 2d. for changing dynamo pulleys, and men's time running plant and charging accumulators, defendants said the condition was never complied with. Alternatively they pleaded that the items arose in respect of work which was not done at their request, and which was not necessary for the purposes of the contract. Particulars of defects and imperfections in the work had been delivered to the plaintiffs, but they refused to complete the same. Defendants further said that they would be compelled to complete the contract by other contractors at a cost of £250 to £400, and that they were entitled to deduct that amount from the plaintiffs' claim. Defendants paid into Court £250 in satisfaction of plaintiffs' claim, and contended that that sum was sufficient to satisfy it without taking into account their counterclaim for damages for defects and imperfections in the installation. By the contract, plaintiffs undertook to complete the installation within six weeks from the date they were instructed to commence work by defendants' engineer, which was March 14th, and on December 8th, 1905, their men were withdrawn. By one of the conditions of the contract, it was provided that, should the plaintiffs not complete the works in accordance with the conditions they should pay to the defendants by way of liquidated damages £5 per day for every day the work remained uncompleted. Part of the delay was caused by matters for which the plaintiffs were not responsible, and the defendants were willing to allow plaintiffs five months for the delay so caused. Alternatively the defendants pleaded that they had suffered great inconvenience and loss through plaintiffs withdrawing their men on December 8th, and had been compelled to lay on a supply of gas in their workshops, the cost of which amounted to between £60 and £70, and they would be put to further expense until the installation was made in accordance with contact. In their particulars defendants alleged that the dynamos provided by plaintiffs were not capable of maintaining 150 amperes at 100 volts, the specified output at a specified speed not exceeding 850 r.p.m., or a corresponding output at any voltage up to 140. Defendands also said that the dynamos were not suitable for charging the battery, as the contractors had installed, in addition, a motor-booster for the purpose of giving the extra pressure for charging the battery. Other defects in the dynamos were alleged. Various deficiencies in the switchboard were represented by the defendants, who further alleged that certain work in connection with the distributing fuse-boards was not in accordance with the Institution of Electrical Engineers' rules. As regarded the arc lamps, defendants said the galvanised wire twisted round the lamp hook and round the beams was not satisfactory work. The casings in the offices were alleged to have been fixed in many places in inaccessible positions, and for the main circuits and the aerial cables in the main shops the plaintiffs were said to have provided only braided cables without insulation. These cables, defendants stated, were not in accordance with the contract, nor would they prevent short circuit or possible danger to persons. Not only were joints placed where braided cable changed to vulcanised rubber cable, but defendants alleged that they had been inserted for branches to individual lamps and for common returns used in cases where two arc lamps were near together. The regulations had been ignored, and the specification in no way complied with. Various alleged defects and imperfections as regarded the wiring in general were also complained of by the defendants; and as to insulation tests, they represented that the works as executed did not comply with the rules of the Institution of Electrical Engineers or the requirements of the Fire Insurance Companies.

In reply, plaintiffs denied that the terms of the contract were correctly stated by the defendants. They alleged that on December 11th, 1905, Mr. Jenkinson, the defendants' engineer, after inquiring into all the matters alleged in certain letters written by the defendants, decided and allowed the plaintiffs' claim at £935 14s. 1d., and gave a certificate that they had finished their work and were entitled to the sum. Plaintiffs submitted as a matter of law that the defendants were not entitled to go behind this certificate, and were stopped thereby. Plaintiffs denied that the work was not finished at the time of giving the certificate. Alternatively they pleaded that so far as it was not finished, it was occasioned by the defendants' own conduct, and that they had always been ready and willing to complete such part of the work as they were bound to complete in accordance with the terms of the contract. Plaintiffs denied that any of the work had been done imperfectly or improperly or that they had refused to remedy the same, or that the defendants, to complete the contract, would have to pay other contractors from £200 to £400. They specifically denied every allegation to the contrary delivered in defendants' particulars. The whole of the work, plaintiffs represented, was submitted to, approved, and passed by the defendants' engineer, and was in accordance with the contract. So far as any delay took place, plaintiffs submitted that that was caused entirely by defendants' own conduct. In particular, plaintiffs said that the defendants were unable to specify the places where the lamps were to be fixed, and in consequence delay was occasioned. It was also asserted that there was delay in building the engine house and in not having the gas engine ready for operation. Plaintiffs denied that five months was a proper allowance for the delay caused by the defendants' conduct and by other matters for which they were not responsible, and contended that the defendants had suffered no damage whatsoever because of their conduct in carrying out the contract. In a rejoinder, defendants submitted that their engineer had given no final decision on the matters in dispute, and that the document of December 11th, 1905, was neither a certificate nor a final certificate, and was of no legal value.

Mr. C. A. Russell, K.C., and Mr. Herbert Smith (instructed by Messrs. Swepstone & Stone) appeared for the plaintiffs, and Mr. Arthur J. Ashton and Mr. E. Grimwood Mears (instructed by Mr. W. Ivanhoe Thomas) for the defendants.

Evidence was given on behalf of the plaintiffs as to the contract and the work done under it.

The further hearing was adjourned.

THE CORPORATION OF NORWICH *v.* THE NORWICH ELECTRIC TRAMWAYS CO.

ON Tuesday in the Court of Appeal, composed of Lords Justices Vaughan-Williams, Stirling and Fletcher Moulton, the defenders' appeal in this case against the decision of Mr. Justice Phillimore came on for hearing. The action was brought to recover a small sum paid by the Corporation for the repair of certain roads said to have been injured by the company, and both parties sought a declaration as to their respective rights under the Norwich Tramways Act, 1897, which Act incorporated the provisions of the Tramways Act of 1870. It seemed that by Sec. 28 of the latter Act a company had to keep in good condition to the satisfaction of the local road authority so much of any road whereon any tramway belonging to them was laid as lay between the rails of the tramway, and (where two tramways were laid by the same company in any road at a distance of not less than 4 ft. from each other) the portion of the road between the tramways, and in every case so much of the road as extended 18 in. beyond the rails of and on each side of such tramway. By the same section, if the company failed to comply the Corporation could, after giving seven days' notice, open and break up the road and do the necessary work at the expense of the company, with interest at 5 per cent. The tramways in some cases were laid in streets paved with wood, and as to these no question arose. In other cases, however, the roads were made with macadam, the tramways being laid in granite setts, which granite setts extended a short distance beyond the outside rails. The Corporation had had to repair the ridges which had been formed by reason of the macadam becoming worn at certain points. The company's contention was that it became necessary to do this because the surface of the macadam was

bad, and that the whole of it was in need of repair. Mr. Justice Phillimore, on this point, however, decided that in the greater number of cases the macadam was in sufficiently good repair. With regard to the places where the macadam was worn down below the surface of the granite setts, the Corporation contended that the company should pay the cost of the repairs, but the company said that the expense fell on the Corporation. Mr. Justice Phillimore held that in cases such as this where the macadam wore more quickly than the granite setts, the Legislature intended to throw upon the company, as a condition of the privileges given them, the duty of maintaining the due contour of the road by a proper junction of the two surfaces. He, accordingly, made a declaration to that effect, and gave judgment for the plaintiffs for the amount claimed, with 5 per cent. interest and costs. Hence this appeal by defendant company.

Mr. Danckwerts, K.C., and Mr. Henlé appeared for the appellants, and Mr. Macmorran, K.C., and Mr. E. Wilde for the respondents.

Mr. DANCKWERTS said that the appeal was based on two grounds. First, that the learned Judge had no jurisdiction in the matter at all; secondly, that the decision on the merits was wrong.

Lord Justice MOULTON: Do you say that the case ought to have been referred to an arbitrator?

Mr. DANCKWERTS: Yes, I say that the Statute is so framed that the Court never had any jurisdiction. Proceeding, Mr. Danckwerts explained that the appeal came before two of their Lordships in the other Court of Appeal, but was adjourned pending the decision of the House of Lords in the case of Crosfield *v.* the Manchester Ship Canal.

Lord Justice VAUGHAN-WILLIAMS remarked that the defendants had not pleaded the jurisdiction point.

Mr. DANCKWERTS: The point was not taken at the trial, I agree, but it was a point of law which required no evidence one way or the other. The House of Lords has laid it down that refraining from taking the objection cannot operate as a consent. Continuing, counsel said that the Corporation, as the highway authority, were the masters entitled to say how the tramway part of the roadway should be made. They might have a tramroad of granite or wood or macadam, as was the case here. In that case there must be a junction at the point where the two surfaces met. He thought the learned judge had gone wrong by treating the surface as the mathematical plane of the street. Each party claimed a declaration, and his Lordship adopted the form of declaration put in by the Corporation, with a slight amendment. The question to be decided depended upon the construction of the Tramways Act of 1870 in the first instance, and of the defendants' special Act in the second. Having referred to the various sections dealing with the making up and maintaining of the road in both Acts of Parliament, which, said counsel, must be read as one, he proceeded to read Section 33 of the General Act, which, he contended, ousted the jurisdiction of the Court. That section provided "that if any difference arises between the promoters or lessees on the one part and any local authority or road authority on the other hand with respect to any interference or control exercised or claimed to be exercised by them or on their behalf, or by the promoters or lessees by virtue of this Act, in relation to any tramway or work or in relation to any work or proceeding of the local authority or road authority or in respect of the property of or mode of execution of any work relating to the tramway or on the question of whether any work is such as ought reasonably to satisfy the local authority, or whether in respect to any other subject or thing within this Act, the matter in difference shall (unless otherwise provided by the Act) be settled by an umpire or other fit person nominated as reference by the Board of Trade on the application of either party."

Mr. DANCKWERTS contended that by this section a specific tribunal was chosen because of its peculiar fitness to deal with such disputes as the present, and that being so, the Court had no jurisdiction in the matter.

Lord Justice MOULTON: But this point was not taken before Lord Justice Phillimore.

Mr. DANCKWERTS said that was so, but it was quite open to him. Consent would not give jurisdiction if no jurisdiction existed.

Lord Justice MOULTON: In a case of the South-Eastern Railway Co. against the London Chatham and Dover Railway Co. the Court of Appeal held that an objection to jurisdiction under the Railway Clauses Act (which is one of the Acts which provides a special tribunal) which was not taken until the case had been tried, amounted to a waiver.

Mr. DANCKWERTS: You cannot waive it.

Lord Justice VAUGHAN-WILLIAMS: My recollection of the case is not quite the same as Lord Justice Moulton's. It was a case in which either side had power to insist upon an arbitration, but they did not insist in time.

Mr. MACMORRAN: Your Lordship is quite right.

Mr. DANCKWERTS said there could be no question as to the Act in question, and he cited several authorities with a view to showing that, although the point as to jurisdiction was not taken in the Court below, it might be raised in the Court above.

Lord Justice VAUGHAN-WILLIAMS said that before proceeding to the second point—the question on the merits—he should like to hear Mr. Macmorran on the jurisdiction point. If the Court were to decide the point in favour of the appellants it would not be necessary to go into the other question, as it would end the whole matter so far as the Court was concerned.

Mr. MACMORRAN submitted on behalf of the Corporation that the want of jurisdiction point had been taken too late. His second point was that the learned judge had jurisdiction under Sec. 57 of the Act of 1897 to deal with the case. He said the action was brought for a small sum of money under a Statute, the meaning of which was in dispute. In addition, the Corporation claimed a declaration as to their rights under the section which was in dispute—a declaration, in fact, as to the meaning of the section. Defendants put in a defence to this, and, amongst other things, they themselves claimed a declaration as to the meaning of the same section. Those were the only questions raised in the Court below. If the case went before an arbitrator, he would be sure to be asked in the end to state a special case, and therefore it would come again before those Courts on the same question. He urged that the objection raised was quite futile. He did not know of any case where such an objection had been given effect to.

Mr. WILDE followed on the same question, and

Mr. DANCKWERTS having briefly replied,

Lord Justice VAUGHAN-WILLIAMS gave judgment. He said that with regard to the argument put forward on behalf of the respondents, that the point as to jurisdiction was taken too late, his opinion was that want of jurisdiction could be raised at any time, and the defendants were not stopped from raising it in that Court. Section 33, if it applied, did oust the jurisdiction of the Court, because it appointed a special tribunal to settle these disputes. Speaking for himself, he thought they must read Section 33 of the Tramways Act, 1870, just as if it had been printed as part and parcel of the Special Act. He thought that the dispute in question was a dispute covered by Section 33, and that it, therefore, applied so as to oust the jurisdiction of the Court. The appeal must, therefore be allowed.

Lord Justice STIRLING concurred. He said Sec. 33 clearly ousted the jurisdiction of the Court. It was a section which closely resembled that which was the subject of the decision of the House of Lords in the case of Crosfield *v.* The Manchester Ship Canal Co. His Lordship was unable to see that the defendants had waived the objection so as to prevent it being raised now. The only question which remained, was whether this case came within Sec. 33. He thought it did, because it was a dispute which related to the propriety of, or the mode of the execution of the work, or to the question of whether "the work was such as ought reasonably to satisfy" the Corporation. He was unable to see that Sec. 57 of the private Act conferred express rights at variance with this view.

Lord Justice MOULTON gave judgment to the same effect, and the appeal was allowed.

Lord Justice VAUGHAN-WILLIAMS said that in view of the fact that the point as to jurisdiction was not raised before the appeal, the order of Mr. Justice Phillimore giving the plaintiffs the costs of the trial must stand. With regard to the appeal, each party must pay their own costs.

Order accordingly.

BUSINESS NOTES.

Siemens's Contracts.—The following is a list of a few contracts that have recently been booked by MESSRS. SIEMENS BROS. & Co., LTD.:—

For the Duffryn Rhondda Collieries Co., Ltd.—One Siemens-Ilgner electric winding engine, consisting of a Koepe pulley, with direct-coupled motor driven by a fly-wheel motor-generator. System: 2,200 volts 25 cycles, three-phase. Capacity: 1,500 tons in 8 hours from a depth of 520 yards.

For the Corlett Electrical Engineering Co., for Axwell Park.—One Siemens-Ilgner electric winding engine, consisting of a cylindrical drum winder with geared motor driven by a fly-wheel motor-generator. System: 5,500 volts, three-phase. Capacity: 3,500 lb. from a depth of 253 ft.

For the United Alkali Co.—Two Siemens-Ilgner winding engines. Each engine will have a cylindrical drum and gear motors, and will be driven by a common fly-wheel motor-generator. System: 3,300 volts 25 cycles, three-phase. Capacity: (1) 400 tons in 8 hours from a depth of 164 yards; (2) 160 tons in 8 hours from a depth of 164 yards.

For Messrs. Pilkington Bros., Ltd.—Complete electrical equipment of glass works, comprising two 660-KW. and one 330-KW. continuous current generators, with flexible couplings for direct coupling to gas engines; five 450-B.H.P. and three 180-B.H.P. motors, for driving polishing and grinding benches; one 70-KW. motor-generator, two 40-KW. balancers, main switchboard and all the necessary control apparatus, distribution boards, mains and accessories.

For the Bristol Docks Committee.—Two electric telphers for handling casks of tobacco in the new tobacco warehouses.

For the War Office.—Two 1,500-KW. continuous current generators, direct coupled to Yates & Thom engines, 85 r.p.m., for Royal Arsenal central power station, Woolwich.

For Mr. P. J. Mitchell.—One 250-KW. high-speed alternator, for direct-coupling to Rateau turbine, and one 500-KW. ditto.

For Messrs. Willans & Robinson.—One 375-KW. high-speed alternator for direct coupling to Willans turbine. Speed: 3,000 r.p.m.

Electricity in Printing Offices.—The large block of buildings in Long Acre which has been acquired by Messrs. Odhams, Ltd., and Messrs. Southwood, Smith & Co., Ltd., is being equipped throughout with electric lighting and power, under the supervision of Mr. Frank Broadbent, M.I.E.E., consulting engineer, who has also in hand the electrical work at the printing offices of Messrs. Cassell & Co., Ltd., Messrs. William Potter & Sons, Messrs. Alabaster, Passmore & Sons, the Co-Operative Printing Society, Manchester, &c. The electrical work at Messrs. Hudson & Kearn's new works was also designed and supervised by Mr. Broadbent in collaboration with Mr. A. D. Stevenson.

Paxman-Lentz Steam Engines.—An order has just been placed with MESSRS. DAVEY, PAXMAN & Co., LTD., for ten horizontal compound steam engines, on the Paxman-Lentz system, of an aggregate of 7,000 H.P., which are for an electric light installation. The firm are sole licensees for the manufacture of this type of engine.

"Sunlite" Reflectors.—Amongst contracts recently completed by the SUN ELECTRICAL CO., LTD., are:—Over 1,000 ft. for Messrs. F. Sage & Co.; 405 ft. and 135 ft. of special curved "Sunlite" for Messrs. Waring & Gillow's new premises in Oxford Street; 250 ft. for another well-known London house.

Bandstand Illumination.—The IMPERIAL LIGHTING Co., of London, have received instructions from the Borough Council of Margate, to illuminate, on their patent "Fairyland" system, another of its bandstands, namely, the Oval, as the one illuminated by the same company last year (the Fort bandstand), proved successful in every respect, especially from a financial point of view, the receipts, after paying all capital charges, leaving a substantial balance. As each bandstand has 800 8-c.p. lamps, thus making a total of 1,600 in all, this new departure opens a further and remunerative field worthy of the attention of supply station engineers.

Expansion Joint.—In our issue of February 23rd last, one of our correspondents drew attention to the want of a good reliable expansion joint for steam, and suggested that should any of our readers bring out such a joint, steam users all over the world would welcome and adopt it. We are now informed by Mr. A. CHRISTIE, of 134, Upper Thames Street, E.C., that at that date he was working on such a joint, which he has since perfected and protected. Mr. Christie claims that it is simple, has no packing, and works positively under any pressure; and that it can be opened and closed in a few minutes by even an inexperienced labourer.

Book Notices.—*Motor-Car Mechanism and Management. Part I: The Petrol Car.* By W. Poynter Adams. London: Charles Griffin & Co., Ltd. Price 5s. net.—Mr. Adams is to be congratulated on having produced a work which should be of valuable assistance to the rapidly growing army of amateur motorists and professional drivers of automobiles The book before us is of an elementary character, and forms the first volume of a set of three, in which the three main sources of power for motor-vehicle propulsion—petrol, electricity and steam—will be dealt with. The author has wisely assumed that his reader has no previous knowledge of mechanics or engineering, and therefore sets out to deal with the various components of a petrol car in as clear and simple language as the subject under discussion will permit. The volume is divided into two sections, the first being devoted to the mechanism of the petrol car and its underlying principles, and the second relating to the management of such vehicles and their maintenance in good running order. Part I is divided into five chapters, the first one of which is devoted to a description of the component parts of the engine itself, and to a lucid explanation of the Otto cycle of operations in internal combustion motors, clearly-drawn diagrams showing the position of the inlet and exhaust valves at each stroke. Chapter II brings us to what may be termed the external adjuncts of the petrol engine—the petrol supply, the carburettor in which the explosive charge is formed, the exhaust silencer, the water-cooling and lubricating systems, and the methods of engine speed control. These are all dealt with so clearly that we hardly like to criticise, and it is therefore with some diffidence that we suggest a reference might be included to the variable valve lift as a substitute for the ordinary throttle valve in varying the supply of gas to the combustion chamber. Chapter III deals with the question of electrical ignition and accessories, and here, as may be expected, the author is quite at home with his subject, the action of the induction coil, in accumulator ignition, and of magnetos being very exhaustively treated. Some interesting experiments with regard to the properties and power of petrol are detailed in Chapter IV. The frame and the mechanism for transmitting the power of the engine to the rear road wheels are dealt with in the subsequent chapter, and while the author's remarks are well to the point, they could, we think, have been usefully amplified, while the inclusion of a drawing of a change-speed gear and of the clutch and brake pedal connections would have rendered the chapter of greater value. The subject of steering gear is also conspicuous by its absence. Sec. II, on the management of the petrol car, will be found extremely useful by all who have made the plunge into the automobile world, not merely in recent months but even since the motor-car became a legalised form of locomotion in this country. In the five chapters comprising this section, the various points about a petrol car requiring attention and adjustment are exhaustively dealt with, and the whole gamut of the troubles likely to be met with on the road considered. The writer, who has been an amateur motorist for some years, and who prides himself in doing all his own repairs and adjustments to his car, is free to admit that he has picked up a wrinkle or two from the author. On the other hand, he disagrees with the method of chain lubrication recommended. A dirty chain should on no account be placed in the hot fluid grease, but should be previously well cleaned in paraffin, several baths being given until all dirt or grit has been removed. The chain should then be wiped dry and placed in the warm grease bath, in which it should be allowed to remain until the grease and chain form one solid mass. To sum up, Mr. Adams's book is a very useful addition to the rapidly-increasing library of automobile literature, and may be strongly recommended to all who, finding their friends becoming owners of motor-cars, are beginning to foster a desire to follow their example, but before actually taking the step are anxious to know a little more of the why and wherefore of the various parts of a motor-car. The book concludes with a glossary of automobile technical terms and their definitions, and a useful index.

Heat and Steam (Elementary). By Engineer-Commander A. E. Tompkins, R.N. Portsmouth: J. Griffin & Co. 1906. Price 1s. 6d. net.—This paper-covered pamphlet of some 54 pages is intended as a supplement to the second edition of the author's "Text-book of Marine Engineering." Its compilation was due to the issue by the Admiralty of an amended syllabus for instruction in steam-engine thermo-dynamics. A perusal of its pages vindicates the claim of the author's preface as to covering the scope of the new syllabus. Generally the definitions given are succinct and satisfactory; with so many earlier text-books on which to base them, error here would be inexcusable. But certain incongruities occur. Why the orthodox table of properties of saturated steam (page 15), with weights per cubic foot carried out to the fifth place in decimals, and later (on page 49) as a rough general rule, the I.H.P. of an engine (other than a turbine) driving a dynamo, equalling the product of the amperes and volts divided by 500? Also we do not wholly care for the author's dissertation on efficiency. The sources of loss are slurred over, and an undue efficiency claimed for turbine propulsion as against reciprocating engines. It is difficult, however, to judge the supplement without the manual. The proof of the fare provided at a meal should not be judged by the ices or by the coffee, or other refreshments of civilisation, but by the general sense of satisfaction provided by the more substantial foundation. A reviewer sitting in judgment on a supplement probably resembles a gourmet arriving at the ices or coffee stage.

"Bulletin of the Imperial Institute (Quarterly)." Vol. IV, No. 1, 1906. London: The Institute. 1s.

"Notes on Electro-Chemistry." By F. G. Wiechmann. New York: McGraw Publishing Co. $2 net.

"Electric Transmission of Water Power." By A. D. Adams. New York: McGraw Publishing Co. $3 net.

"High-Tension Power Transmission," Vol. 2. A series of papers and discussions presented at the International Electrical Congress in St. Louis, 1904. New York: McGraw Publishing Co. $2.50 net.

"Modern Buildings: Their Planning, Construction and Equipment." By G. A. T. Middleton. Vol. II. London: The Caxton Publishing Co. 10s. 6d. net.

"Proceedings of the American Institute of Electrical Engineers." Vol. XXV, No. 4, April, 1906. New York: The Institute.

"Practical Testing of Dynamos and Motors." By C. F. Smith. Second Edition. Manchester: The Scientific Publishing Co. 5s. net.

"Fire Tests with Doors." Red Book No. III of the British Fire Prevention Committee. London: The Committee. 3s. 6d.

"Journal of the Institution of Electrical Engineers." Vol. XXXVI, No. 177, April, 1906. London: E. and F. N. Spon, Ltd. 5s.

"The Business Blue Book." London: Curtis, Gardner & Co., Ltd. 2s. net.

Switzerland.—La Société de la Fabrique d'Accumulateurs Oerlikon is declaring a dividend of 20 fr. per share for the last financial year.

Dissolutions and Liquidations.—PSYCHILOID, LTD.—This company is winding up voluntarily, with Mr. G. S. Greening, 18, Norfolk Row, Sheffield, as liquidator.

P.M. ELECTRIC MANUFACTURING CO., LTD.—This company is winding up voluntarily, with Mr. Elles Hill, 79, Mark Lane, E.C., as liquidator.

LOCKERBIE & WILKINSON, LTD.—Creditors must send particulars of claims to the liquidator, Mr. A. H. Gibson, 39, Waterloo Street, Birmingham, by June 30th.

OLDSMOBILE CO. OF GREAT BRITAIN, LTD.—This company is winding up voluntarily, with Mr. James Carroll, 51, Darenth Road, Stamford Hill, N., as liquidator.

THE ELECTRIC WORKS CO., LTD.—A meeting is to be held at 9, Parr Street, Liverpool, on Friday, June 15th, to hear an account of the winding up from Mr. D. L. Chambers, the liquidator.

NERNST ELECTRIC LIGHT, LTD.—A meeting is to be held at the Westminster Palace Hotel, on June 18th, to hear an account of the winding up from the liquidator, Mr. M. Levinger.

Consular Notes.—RUSSIA.—The British Consul at Moscow reports that the conversion of the Moscow tramway system to electric traction (overhead trolley) is progressing, though in consequence of the disturbances, the progress made is somewhat slower than was anticipated. There is a steady increasing demand for electrical appliances, and it is now stated that a German syndicate has concessions from the Ministry of Finance, and that its representatives are travelling about Russia and inspecting various large towns with a view to installing electric light plant and starting electric tramways. This shows that competitors of British goods are well on the alert. In local shops nearly all the electrical appliances for show are of German manufacture. Over three-fourths of all the electric plant used in Russia is stated to come from Germany, and the following figures would certainly seem to bear this out. Unfortunately, the customs returns do not show electric plant under a separate heading. However, under the heading "electric lighting, mathematical and surgical instruments and photographic appliances" we see:—

	1903.	1904.
Total imports	4,013,000 roubles	4,090,000 roubles.
From Germany... ...	3,036,000 „	3,156,000 „
„ United Kingdom	187,000 „	184,000 „

It is stated that electrical appliances form from one-fifth to one-fourth of the total imports mentioned above; however, this does not include electrical machinery, which is not shown separately, but comes under the general heading of machinery. Part of the contract for the new electric tramcars for Moscow was secured by a British firm which has supplied up to date (report dated April 17th) 19 cars. It is also stated that the same firm has secured part of the order for the new electric tramcars for St. Petersburg.

FINLAND.—The British Consul at Helsingfors in a recent report states that the Communications Department of the Senate of Finland has reported that the question of electric railways is an important one to that country. It is beyond doubt possible and practicable to work the majority of the Finnish railways by electricity, the power being taken from the rivers Vuoksen and Kymmene. The Imatra Rapids are mentioned, too, as a site for a power station. The Communications Department suggests that a committee should be appointed to gather all information on the matter. The town council of Helsingfors has finally decided to start its own municipal electrical works, intended to supply the whole city with all the electric power required. For this purpose a preliminary loan of £100,000 is to be raised, but this sum by no means expresses the total cost of the enterprise. A committee is elaborating the details as to where the electric station shall be, whether all shall be built new or the already existing private works be bought up. Most of the manufactories have their own installations, and some house owners also. The greater part of the electric light and power supply is in the hands of two firms, and the electric tramway company has its own power station.

Swedish Copper.—The LAKE COPPER PROPRIETARY CO., among the list of directors of which we find the name of Mr. James Swinburne, F.R.S., M.Inst.C.E., is stated (in the *Financial News*) to have acquired "the entire share capital of the Swedish company, owning 77 mining leases and extensive freehold lands and timber properties at Stora Strand and at Vingnäs, in the south-western part of Sweden, about 90 miles north of Gothenburg. The mines are very easily accessible, both by rail and water, freights are stated to be very low, labour plentiful and cheap, timber abundant on the properties, and the company announces that it has entered into an agreement for an ample supply of electric power from a big local power station at 'very low rates, not exceeding £4 per H.P. per annum.' The properties are to be developed entirely by electric power."

For Sale.—The Marylebone Electricity Department is offering for sale a good deal of second-hand steam and electrical plant.

On June 12th, Mr. JOHN SULLEY will sell by auction certain rubber manufacturing machinery in London. Some particulars appear in our advertisement pages to-day.

Factory Accident Prosecution.—At Llangollen last week, the local E.L. and power company were fined 10s. and costs for not reporting an accident to the Inspector of Factories. The accident referred to was an engineer's fall from a ladder.

Catalogues and Lists.—MESSRS. MATHER & PLATT, LTD., Manchester.—A revised edition of the pamphlet on Dr. Rosenberg's patent train lighting system, for which Messrs. Mather and Platt own the patents in the United Kingdom and the Colonies.

MESSRS. J. H. HOLMES & Co., Newcastle-on-Tyne.—Pamphlet No. 102 (32 pages) wherein are given some half-tone views and some lengthy lists of factories, general stores, and trades for which they have manufactured and installed electric generating and driving plant. The pictures show the Mazawattee Tea Co.'s works at New Cross, Newcastle Breweries, electrically-driven dough-mixing, box-making, and chocolate-grinding machines, &c.

MESSRS. J. F. SMITH & Co., 10 and 12, Edmund Street, Birmingham.—Supplementary catalogue of their patent system of electric lighting fittings, which is claimed to be a jointless wiring system and to do away with the complications of switch wiring, saving labour and materials, and to save 25 per cent. of the usual cutting away of joists, wall chasing, &c.

MESSRS. JAMES BALDWIN & Co., Devonshire Brass Works, Keighley.—A new catalogue (48 pp.) containing illustrated descriptions of their new patent safety valves. Great care has been bestowed upon the production of half-tone illustrations showing both sectional and general views of the "New Deadweight" and "New Spring" valves for high steam, also the "Self-assisting" dead-weight, the "New Compound" valves for high steam and low water, "Simplex" stop valves, "Nomis" water gauge, "Betall-Accessible" check feed valve, &c. Prices are given in most cases, and standard flange dimensions are stated in tabulated form.

MESSRS. SMITH, PARFREY & Co., LTD., Hammersmith, W.—Price list of wheels with iron, steel and rubber tires; also springs, axles, &c.

MESSRS. ELLIOTT BROS., Lewisham.—Pamphlet R91, briefly describing and showing their new form of Wheatstone bridge.

MESSRS. W. J. FURSE & Co., Traffic Street, Nottingham.—Section L (24 pp.) of their catalogue contains descriptions with some clearly printed illustrations, also prices, of their lifting and haulage machinery, including direct-coupled winding gear for passenger and goods elevators, electric, belt-driven and hand-power lifts. Wall hoists, dinner lifts, crab winches, overhead travellers, collapsible gates, &c., are included.

SUNBEAM LAMP CO., LTD., Gateshead-upon-Tyne.—Several new pamphlets relating respectively to the company's heating lamp for electric radiators, the "Outshine" lamp, fans, ironclad switches, motor starters, and "Switch" and "Tilting" types of reducing lamps (two filament turning down). All of the lists are illustrated and give prices; copies may be obtained on application to the company.

MESSRS. W. H. BAILEY & Co., LTD., Salford.—Illustrated publication, No. 106, describing their stationary steam fire engines for fire protection, sprinkler installation and other purposes.

THE UNIVERSAL ELECTRIC SUPPLY CO., 60, Brook Street, C.-on-M., Manchester.—Illustrated price list (88 pp.), tenth edition, of their various electrical novelties, sundries and manufactures, including electric bells, burglar alarms, batteries, electric light sets, medical coils, model dynamos and motors, tools, and hundreds of other things.

MESSRS. J. R. PEARCE & Co., Old Hall Street, Liverpool.—Small pocket pamphlet setting forth the properties of their acid-resisting composition used by electrical and other trades as a preservative for metals, wood, &c. The firm has just laid down a special plant for the manufacture of the composition.

Boiler Water Circulator.—According to the pamphlet of the British Boiler Water Circulator Syndicate, their particular circulator is an apparatus placed inside the boiler, and through it all water which enters the boiler is made to pass for the purpose as stated of heating, cleaning and softening it as well as of extracting from it any grease. We believe all these aims are good, for water should certainly be clean and free from oil and scale-forming matter, and it ought not to mix in the boiler until it is heated to full boiler temperature and has acquired that liveliness of movement which seems to appertain to heated water, and also does much to enable a boiler to be worked at a heavy output without scaling. From an illustration of the apparatus, as applied to an internally-fired boiler of Lancashire type, the apparatus consists of a settling vessel placed between the two furnace or flue tubes and fitted below with a blow-out pipe and above with a pipe that skims the surface of the water in the boiler and delivers with the fresh feed into the aforesaid vessel; another pipe on the other side of a divisional plate discharges the water whence the sediment has settled out, to the bottom of the boiler. Two of the cross tubes of the boiler appear also to be joined up to the circulatory system. If this description is not correct, the fault lies with the lack of information contained in the circular. The whole apparatus appears to us to act much on the lines of the Hotchkiss boiler-cleaner, though this is placed externally to and on the top of the boiler, and if the circulator acts as well as this apparatus, it should certainly be valuable. It is claimed that with this circulator a Lancashire or Cornish boiler is made equal to a water-tube boiler in efficiency. This is not much of a recommendation, for the Lancashire boiler is by many considered superior to the water-tube boiler. Presumably, the grease is supposed to settle with the mud, but will all of it do so? There seems to be no means of blowing off any grease that rises to the top of the settling chamber.

Trade Announcements.—Mr. GILBERT LITTLE, of Smethwick, has purchased a new engineering works at Great Horton, Bradford, which is erected on modern principles and conveniently adapted for the purposes of the Gilbert Little Co., Ltd., with which he is associated. It is anticipated that the works will be in full swing next July.

We paid a visit the other day to the London showrooms of MESSRS. C. J. THURSFIELD & Co., of Birmingham. These are situated at 21A, Berners Street, W., where Mr. E. C. Sparkes acts as their sole London agent. Some excellent examples of hammered and cast metal work in oxidised and other finishes are on view; they include many varieties of imposing lantern fittings, brackets, standards, and so forth, but it is hardly necessary to show these now as our readers have already been made fully familiar with the character of Messrs. Thursfield's designs through illustrated descriptions in these pages. The London address is not only devoted to showroom purposes, for there is a designing department, in which Mr. E. H. Walker, who has had considerable experience in electric light fitting and architectural designing, is engaged in getting out new designs to meet customers' requirements.

The I.T.E. ELECTRIC Co. have opened offices at 20, Great Russell Street, London, W.C., where a stock of I.T.E. circuit-breakers will be carried and a representative variety of types be placed on exhibition. Mr. W. Everett Gibson, who has been associated with the above circuit-breakers for many years, has been appointed manager.

MESSRS. STEVENSON & M'GUFFIE, consulting engineers, have removed to new offices at Caledonian Chambers, 87, Union Street, Glasgow.

Screw-Cutting Indicator.—A very neat little device has been brought out by MESSRS. PERCIVAL MARSHALL & Co., entitled the "Model Engineer" Screw-Cutting Indicator; it consists of a circular card rotating behind another, and showing at an aperture in the latter the numbers of the wheels to be put on the lathe to cut any desired thread. It is made in three patterns, to suit lathes having guide screws of two, four and eight threads per inch respectively. Each indicator is enclosed in a case to keep it clean.

Bankruptcy Proceedings.—ALBERT DICKINSON, electrical engineer, Wortley, Leeds.—A receiving order was made at Leeds County Court last Saturday.

Tantalum Lamps.—MESSRS. SIEMENS BROS. & Co., LTD., announce that the list price of the tantalum lamp is reduced, as from to-day, from 5s. to 2s. 9d.

LIGHTING and POWER NOTES.

Belfast.—A L.G.B. inquiry was held on the 11th inst. into (*inter alia*) an application to borrow £10,000 for extensions to the E.L. system, made up as follows:—£1,835 for a sub-station at Fort William, £2,265 for mains in connection therewith, £1,400 for sub-station plant for supplying the Cavehill and Whitewell tramways, £3,000 for small extensions, and £1,500 for meters. During the inquiry it was stated that in regard to the Cavehill tramway

the Corporation has an agreement with the company under which it is to receive a minimum of £1,250 per annum for energy. The amount apportioned is 150,000 units at 2d., above that and up to 175,000 1¾d., and beyond 1½d. The profit on the undertaking during the year was stated to be £6,691.

Birmingham.—The revenue account of the past year's working of the city electrical undertaking shows a credit balance of £41,458, as compared with £39,574 last year. Interest and sinking fund charges amount of £35,360, leaving a balance of £6,098 compared with a net profit of £10,789 as at March, 1905. The reduction is accounted for by capital expenditure on the new works at Summer Lane and mains in connection therewith. The number of units sold amounted to 5,383,904, as against 4,645,027 in the previous year. The Electric Supply Committee has followed the course approved by the Council last year, in carrying the surplus to the reserve fund. Further capital expenditure will be incurred during the current year, and the Committee anticipate a deficiency in next year's accounts. The total length of new mains laid during 1905-6 was 15,703 yards, and the total additional connections in equivalent 16-C.P. lamps were 30,808 as against 16,168 in the previous year—this including 1,508 H.P. of motors as against 375 H.P.

The E.L. Committee has agreed with the Tramways Committee that energy for traction purposes shall be supplied within the city at the following rates, subject to revision in 1908:—The first 4,000,000 units per annum at 1½d. per unit; the second 4,000,000, 1¼d.; any quantity in excess of 8,000,000, 1d. per unit net.

Bolton.—A Lancashire correspondent says that the Bolton Electricity Committee has transferred £5,592 from the department in aid of the rates.

Boston.—The T.C. has approved of the draft prov. order issued by the B. of T. to the National Provincial Electricity Corporation, Ltd. The Council is to have the option of purchasing the undertaking at the end of 22 years.

Brandon.—The U.D.C. having decided not to carry out an E.L. scheme of its own, has decided to adhere to its previous decision to consent to the application of the Mid-Durham E.L. Co. for a prov. order subject to overhead wires not being used, and the undertakers having no power to sell the undertaking to another company.

Brighton.—The T.C. on May 10th decided to adopt a flat rate of 5d. per unit for consumers at Aldrington, in lieu of the present maximum demand system.

Bristol.—At the annual meeting of the Bristol Chamber of Commerce, some information was given in regard to electrical matters. At the Avonbank station (erected in two instalments) the plant now consists of:—Twelve B. & W. boilers with a total evaporative capacity of 220,000 lb. of water per hour; six single-phase alternators, generating at 2,000 volts, two driven by Willans central valve engines, and four by Parsons turbines, and totalling a capacity of 4,350 KW.; two three-phase alternators, generating at 6,600 volts, coupled to Willans steam turbines, and totalling 2,000 KW.; three D.C. generators of 540 KW. total capacity, coupled to Willans engines, the total capacity of the station being 6,890 KW. A 3,000-KW. single-phase turbo-alternator is to be erected in the autumn of this year. H.T. switchboards similar to those installed at Temple Back have been erected, and the extra H.T. switchboards for the three-phase system are built on the same lines. The foundations for a third instalment of plant are completed, and building will be proceeded with during the spring.

At Temple Back during the past year the motor-generator equipment has been partially installed, two 500-KW. motor-generators and the necessary switchboards having been erected. The total capacity of the Temple Back works is now 3,160 KW. Considerable extensions of the mains have been carried out. Amongst the most important are those to Stoke Bishop, Westbury, Cold Harbour and Downs Park Estate, new underground transformer sub-stations, and, in some instances, transformer pillars having been constructed and equipped to supply the wants of the consumers in the area mentioned. A special rotary converter station is in course of construction, and is to be worked in connection with the extra H.T. three-phase system. The energy is to be transformed from three-phase current at a pressure of 6,000 volts to D.C. at 500 and 250 volts respectively. A small extension of arc lighting is being carried out, the new roads approaching the new Swing Bridge at Ashton Gate being lighted electrically. It is proposed to adopt a new type of flame arc lamp. Last year, after meeting interest on capital and paying off sinking fund, together amounting to £25,677, there was a net profit of £12,075, of which latter amount £2,231 was utilised to pay interest for an additional three months, owing to an alteration in the date of making up the accounts, 15 months' interest being paid out of the revenue of one year only. The total number of consumers connected on January 26th, 1906, was 2,809, the total number of lamps connected for private lighting was 195,012; for public street lighting on the same date, 686; and the H.P. of motors on consumers' premises supplied from the system, 3,903.

The Electrical Committee has stated that in order to meet the growing demand, it is necessary to increase the capacity of the plant and buildings of the undertaking, and it recommends the C.C. to apply to the L.G.B. for sanction to borrow £103,554. £10,400 is for additions at Temple Back, including £2,122 expended on the restoration after the fire. £57,100 is needed for additions at Avonbank, and £40,800 for additions to the external system, including a special sub-station for the docks. These items total £108,300, but there is a surplus on previous sanctions of £4,745. The C.C. has adopted the Electrical Committee's report.

Carlisle.—The Electricity Committee has submitted a report by the electrical engineer as to the need for extensions. He recommended that a battery of sufficient size to run the trams for several hours independent of the running machinery, should be installed. The scheme has been adopted by the T.C., and the detailed estimate is as follows:—Buildings, £800 to £900; battery (260 cells), £2,450; reversible booster, £400; motor-generator, £400; switchboard and connections, £550; spare armatures, £250; two ventilating fans, £50; 10 per cent. for contingencies, £500; total, £5,500. In moving the adoption of the report, it was stated that during the year just closed the undertaking had earned a profit of £290, and but for a new system of auditing under which the Council had to pay 15 months' interest instead of 12 months, the figure would have been increased to £700.

Chertsey.—The R.D.C. has received from the B. of T. a letter stating that the Sunningdale and District E.L. Co. has decided not to proceed with its application for E.L. powers for the parishes of Windlesham and Bagshot.

Continental Notes.—SPAIN.—The Sociedad de Tranvias de Carthagena has applied for a concession for the extension of the Carthagena-Los Dolores line.

ITALY.—A concession has been granted for the erection of a water-power plant on the Chiagio for supplying Valfabbrica with energy for lighting and power.

A new company has been formed in Milan with a capital of £24,000, to establish an E.L. undertaking in Liguria.

RUSSIA.—The plant at the Société d'Eclairage Electrique de St. Petersburg is being increased by the addition of a 2,500-H.P. steam turbo-alternator.

Dublin.—The Corporation has adopted an alternative flat rate of 4d. per unit for private lighting, and 3½d. for hospitals, licensed houses, &c.

Frome.—The B. of T. has issued an E.L. prov. order to the U.D.C. agreeing to the transfer of the undertaking authorised by the E.L. Order, 1901, to Messrs. Edmundson's Electricity Corporation.

Gelligaer.—Some weeks ago the B. of T. inquired into an application by the U.D.C. for an order for supplying electrical energy throughout the parish. The Board has intimated that it is not prepared to advise the granting of the certificate.

Hanley.—The E.L. Committee has recommended the T.C. not to proceed further with the negotiations for supplying energy to Fenton.

In our note last week we stated that the costs per unit sold for 1905 were 3·51d.; we may add that this figure includes financial charges. The works cost was 1·35d., and including management expenses, &c., 1·99d.

Kingsbury.—The U.D.C. has agreed to transfer its E.L. order to the North Metropolitan Electric Power Supply Co. for a term of 42 years.

Lanark.—E.L. prov. orders have been granted to the County Council by the B. of T., authorising it to supply electrical energy in Bothwell and Blantyre.

Lichfield.—The T.C. has sanctioned an arrangement whereby the E.L. order of Messrs. Foote & Milne is to be transferred to the Shropshire, Worcestershire and Staffordshire Electric Power Co., who will pay £175 to the Council towards its costs in the matter.

London.—BERMONDSEY.—The Electricity Committee has recommended an application to the B. of T. for authority to supply electricity within the parishes of St. Olave, St. Thomas and St. John, Horselydown, and the B.C. has resolved upon a special meeting on July 3rd to consider it.

MARYLEBONE.—At a recent meeting of the B.C. it was pointed out that the E.L. undertaking had overdrawn its banking account to the amount of £74,000, to meet which it had only £34,000 in hand, and he moved that the Finance Committee be instructed to bring up a full statement of the concern's liabilities to date. A motion that the Finance Committee be instructed to bring up a full statement of the liabilities being rejected, Col. A. M. Maude intimated his intention to lay the full facts before the L.G.B. The Electricity Committee has stated that there is a profit on the revenue account at March 31st last of £1,236, instead of an anticipated deficit of £3,374. At the end of the ensuing financial year, after a reduction in the price of energy of ¼d. per unit, a profit of £16,757 is anticipated.

Louth.—The B. of T. having asked the T.C. whether it has taken any steps yet towards carrying out its prov. order, it has been resolved to apply for an extension of four months.

Nairobi (British E. Africa).—The *Cape Times* states that a concession has been granted to Mr. Clement Hirtzel, consulting engineer, to supply electrical energy for lighting and power to Nairobi and district within a radius of 15 miles. The concession is for a period of 10 years, and includes the right to generate power from the three waterfalls on the Ruera River, 18 miles from Nairobi. It is proposed to supply the energy at 2d. per unit for power, and 1s. 8d. per lamp per month for lighting. It is anticipated that it will take about 10 or 12 months to erect and complete the plant.

Newcastle-on-Tyne.—Mr. R. H. Bucknill, M.Inst.C.E., conducted a L.G.B. inquiry at Newcastle-on-Tyne on the 15th inst. into (*inter alia*) the application of the City Council for sanction to borrow £4,500 for lighting certain streets by electricity. The town clerk (Mr. Hill Motum) said there were 200 electric arc lamps in the city, and, by arrangement with the tramways department of

the Corporation, it was proposed to add 180 arc lamps. By reason of the increase in the number of lamps, the Tramways Committee was able to reduce the charge from £15 10s. to £11 per lamp per annum, this figure to include everything in connection with repairs, &c.

The Inspector said the L.G.B. had been refusing loans for electric lighting by reason of the extra cost as compared with gas. He quoted a case where the comparative cost was 1 in the case of gas and 1·74 in the case of electricity. The Board had desired him to go very carefully into this—to take any figures the Council's engineer cared to give him with regard to generating and distributing charges.

The Town Clerk said the Council believed that electricity was the better mode of lighting the streets, that it gave a better light than gas. Under the Act of 1895, in which the Corporation got power to construct and work the electric tramways, they got power also to use electricity for the purpose of lighting the streets.

The Inspector: You would not so light the streets except those in which there are tramways?

The Town Clerk said they could do so, but it would not answer their purpose.

The Inspector said he was not an electrical engineer, but the drop in the charge from £15 10s. to £11 seemed a large one.

Mr. Hatton, the tramways manager, said that at £15 10s. the Committee made a fair margin of profit; by reducing the charge they would make a very small profit. The larger output from the power station would bring down the cost.

The Inspector having pointed to the low cost per unit (·36d.), Mr. Hatton said the traction station worked 17 hours a day, and did not "bank up" as was done at a lighting station.

The Inspector said the Local Government Board was under the impression that no station yet had been able to supply electricity to give as good a light as the incandescent gas, at the same price. The matter had been gone into very carefully by the Board's electrical experts. It would be necessary that the applicants should show that they could give as good a light, and at the same price, as with gas. He would go into the matter later with the tramways engineer.

The inquiry then concluded. We refer to this matter in our "Notes."

Oswestry.—The T.C. has approved of the Bill, as amended, of the Shropshire, Worcestershire and Staffordshire Electric Power Co.

Richmond-on-Tees.—The T.C. has received from 130 ratepayers a petition asking for a system of E.L. to be provided either by the Council or by a company, and the matter has been referred to a committee to consider the advisability of allowing the local E.L. Co. to carry out a scheme.

South Africa.—East London.—The Town Council has secured the services of Messrs. Roberts and Long, electrical engineers of Durban and Cape Town respectively, to inquire into and report on the electric system of the town.

Port Elizabeth.—The electrical engineer reported to the T.C. that good progress had been made with the erection of arc lamps in connection with the new E.L. scheme, and he advised the Council to notify the Gas Co. that after May 1st it would take over the lighting of the Market Square, Main Street and Queen Street. It is hoped to take over all street lighting by the end of July.

Durban.—During March, 14 additional street lamps were erected, the total now numbering 1,366. The erection of a new Belliss-E.C.C. alternator was expected to be carried out last month.

Cape Town.—Notwithstanding the commercial depression, which has undoubtedly seriously retarded the development of the electricity undertaking, Mr. W. F. Long, the city electrical engineer, reports favourably on the year's working. The reduction in the price of energy of 2d. per unit on the maximum charge to private consumers for night supply, with a corresponding reduction in the charge for day consumption, helped towards the slight increase in consumers connected to the supply mains. There has also been an increased day load.

South America.—Rosario.—The municipality recently received two tenders for the public lighting service, one electric and the other gas. The A.E.G. proposes to install 857 arc lamps, charging $12.40 gold per month for each lamp inside the Boulevards and $15.10 for those outside. The Gas Co. offers to install incandescent gas lamps, charging $11 m/n the month per lamp. The Rosario Electric Light Co. did not tender, having had quite enough of municipal contracts.—*Review of the River Plate.*

Tiverton.—The L.G.B. having declined to sanction a loan for the proposed E.L. scheme, the T.C. has decided to dispose of the prov. order.

Toronto.—The Provincial Government is about to appoint a Commission to deal with the electric light and power matters, which are now causing much public discussion and criticism. The Commission will discuss the advisability of fixing the rates charged for light, heat and power by private companies, and, if circumstances warrant it, they will have power to expropriate the business of the companies, or develop the electrical industries with the companies and the municipalities working conjointly. These steps have been made necessary by the public demand for cheaper and more efficient services.

Wednesbury.—The T.C. has entered into an agreement with the Midland Electric Corporation to supply energy to the King's Hill district.

Willesden.—It has been pointed out that although the Metropolitan Electric Supply Co. has no power to lay cables in Willesden, the Council is to offer no objection to the laying of a small section in Coronation Road.

The North Metropolitan Electric Power Supply Co. has received permission from the Council to use its distributing main for the purpose of conveying energy to the new car depôt at Stonebridge. The company will pay at the rate of one-tenth of a 1d. for each unit transmitted.

Wishaw.—The T.C. was recently approached to ascertain if it would be disposed to consider an application to purchase the electricity undertaking of the burgh. After some discussion, the proposal was dismissed.

TRAMWAY and RAILWAY NOTES.

Ardrossan.—At the provisional order inquiry in Glasgow the preamble of the order in regard to the Ardrossan, Saltcoats and District Tramways was proved with the exception of that part to Portincross. The promoters, however, were allowed to run omnibuses between Ardrossan and Portincross.

Birmingham.—The Tramways Committee of the City Council has approved a scheme for the provision along the new tramway routes of telephone call boxes, by means of which drivers and conductors will be able to get into immediate communication with the depôts. A novel departure has been made by concluding arrangements between the Tramways and Watch Committees, whereby the instruments may also be used for fire brigade and police purposes. In this way the street alarms now in use in many of the streets of the city will no longer be required.

On Saturday last a collision occurred between a steam car and an electric car; both were lifted off the rails. There were no personal injuries.

Chile.—A River Plate paper states that the electric tramway service in Santiago (Chile), was recently partly shut down owing to the company running out of stock of carbon brushes for the motors.

China.—A company consisting entirely of Chinese has been formed in British Columbia to construct an electric tramway in China from Canton to San Wu, a distance of 60 miles. Water-power will be obtained from the Quai Tong Shun Mountains, 30 miles from San Wu. The line is to be built by Chinese labour, with Chinese engineers as far as possible. The company also intends to supply light and power in Canton.

Continental Notes.—Germany.—The question of introducing electric traction on the Bavarian State railways continues to engage attention in Germany. It was recently reported that the Berlin Allgemeine Electricity Co. had submitted schemes to the Bavarian Government for the construction of two main lines, but the statement turns out to be without any foundation. It is, however, understood that, at the request of the Minister of Communications, Herr Oscar von Miller has, for the purpose of examination, prepared certain schemes in regard to the railway conditions; but the conversion of the railways to electric traction presents considerable difficulties. It is said that the projects hitherto considered by the Minister have proved to be too expensive, both in initial expenditure and in working. In addition to this, the War Department is apprehensive in regard to proposals for the substitution of electric for steam locomotion on the main lines, as the change might involve great uncertainty and danger in case of the mobilisation of the army and the outbreak of war. In these circumstances it is considered that when any scheme of conversion is undertaken, it will be in connection with subsidiary railways. The Minister of Communications, in the company of railway officials, recently paid a visit to Italy to inspect the electric lines in that country, including that between Lecco and Sondrio.

Spain.—It is reported from Barcelona that a group of capitalists and the proprietor of an important waterfall have purchased the Olot to Gerona Railway, with a view to its electrification and extension to San Juan de les Abadesas; also that the Sociedad Azucarera de Sagre is to construct a line from Menarguens to Lérida, and that a mineral railway is to be built between Calancha and Rio Grande.

Russia.—In his report for the year 1905, H.M. Consul at Helsingfors (Mr. C. J. Cooke) says that it is beyond doubt possible and practicable to work the majority of the railways of Finland by electricity, the power being taken from the Rivers Vuoksen and Kymmene. The Imatra rapids are mentioned, too, as a source of power.—*B. of T. Journal.*

Huddersfield.—It is proposed to extend the Corporation tramway system from Waterloo to Lepton, and from Crosland Moor to Crosland Hill.

India.—Operations are to be begun immediately on the Srinagar-Baramula section of the new Kashmir electric railway.

A draft order has been published for the electric tramway in Delhi, which Messrs. Wilson & Forrest have been authorised to construct.

Liverpool-Southport Railway.—Freshfield, a small station on the Liverpool-Southport Electric Railway, is earning for itself an unenviable notoriety by reason of a remarkable series of fatalities. No fewer than three tragedies have occurred there during the past six weeks. In two instances passengers were knocked down by express trains while crossing the line, and in the third case the live rail appears to have been the agent of death. The victim in this case had not been identified when the inquest was held last week. A driver in charge of the Southport-Dingle car noticed the deceased lying in the 6-ft. way near Freshfield station. According to further evidence the deceased was lying face downwards, with his left arm and shoulder in contact with the live rail. The left arm was burned and nearly severed from the shoulder, and the upper arm and cheek were also burned. Dr. Charlick, who had made a post mortem examination, said the deceased had sustained a compound comminuted fracture of the left upper arm, and a compound dislocation of the left elbow joint. Both these fractures were severely charred. The cause of death was shock to the nervous system, paralysing the action of the heart, in consequence of contact with the live rail. There was no evidence to show how the deceased came in contact with the rail, and the jury returned a verdict that the deceased met his death accidentally whilst he was trespassing on the railway.

The sequence of fatalities formed the subject of discussion by the Formby U.D.C., and the following resolution was passed: "That this Council desires to express its very strong conviction that means should be taken immediately to guard against a recurrence of the recent accidents on the line in the district, and respectfully suggests that, pending the structural alterations necessary, the company should station a responsible man at each station, whose duty it should be to watch the traffic across the line; and the Council would, if desired by the company, consent to alterations with a view to mitigate the danger."

At the Liverpool Assizes on Tuesday an action was concluded in which Laurence Atkinson, a vocalist and teacher of music, sued the L. & Y. Railway Co. for damages for personal injuries received in the great smash at Hall Road Station on July 27th last. The jury awarded the plaintiff £2,500 damages.

London.—L.C.C.—The Council on Tuesday had under consideration the estimates of expenditure and income for 1906-7. It appears that the expenditure on tramways is estimated at £1,061,020. It is calculated that the estimated surplus of £51,063 on the Southern system will be almost entirely absorbed in meeting the deficiency on the Northern system, which is computed at £37,960, and the general charges amounting to £8,861.

Sir R. M. Beachcroft, in dealing with the tramway estimates, stated that the Council would not derive any advantage from the tramways during the next four or five years. Instead of carrying from £20,000 to £30,000 per annum to the relief of the rates, the Council would be unable to do anything of the kind. The tramway undertaking would land the Council in the greatest possible difficulties in the next few years. Yet, if the Council had desired, the North Metropolitan Co. would have converted the Northern system to electric traction at its own expense.

Mr. P. Harris remarked that the Council wished to have further information, especially as to what was being done in regard to charging improvements to tramways, how much had been charged in the past and how much was proposed in the future? If the Council carried out extensive street improvements for tramways, that had a very material bearing upon the system as a revenue-producing service. The net surplus of £3,000 for 1905-6 was really a deficit, because it was pointed out that an adequate amount had not been placed to the renewals fund.

Sir E. A. Cornwall defended the position of the tramways, and after further discussion, the estimates were approved.

The County of London Electric Supply Co. is to supply at 1d. per unit energy for working the tramways between the Angel and Highbury as an extension of the contract for the Kingsway-Islington tramways.

North Metropolitan Tramways.—According to the decision of the arbitrator, Sir Ed. Boyle, K.C., the L.C.C. will pay the company in respect of the residue of the lease and the stock a total sum as follows:—Agreed amount already paid, £120,000; additional sum paid under the terms of the agreement for purposes of adjustment, £17,787; horses, cars, harness, stable utensils, tools, plant, forage and consumable stock, £203,414; a total of £341,202. The costs of the valuation, &c., will, it is estimated, amount to about £9,000. The total additional expenditure, therefore, is £230,000, of which £221,202 will be payable to the North Metropolitan Tramways Co.

Metropolitan Railway.—On Thursday last week an electric train was proceeding to Baker Street when the rear carriage caught fire. The train was brought to a standstill, and the passengers were escorted along the line to the station. The train officials succeeded in extinguishing the flames with sand, but the traffic was blocked for some time.

Shoreditch.—The B. of T. has approved of the proposed side-slot system of underground conduit construction for the L.C.C. tramways in the Kingsland Road.

Manchester.—Mr. G. R. Askwith, K.C., is appointed arbitrator between the Manchester Corporation Tramways Committee and the employés' trade union. The question for the arbitrator is whether, in view of the general conditions of labour of the tramway men of Manchester, compared with those of other towns, the employés of the Committee should be paid time and a-half for Sunday labour.

Newcastle-on-Tyne.—The Tramways Committee has considered "communications" from "the drivers" and "conductors relating to their grievances, and has decided to ask the men to appoint an arbitrator.

Ossett.—The project of laying the electric tramway between Ossett and Dewsbury, to give through connection with the Wakefield system, has now been carried to a successful issue, and electric cars will run between the centre of Earlsheaton and Dewsbury. Cars will also run from the latter town along the Wakefield Road to Ossett, through Chickenley, and on to Wakefield.

Salford.—The general manager's report on the working of the municipal tramways for the year ending March 31st last shows an increase of gross profit over the previous year of £5,509. The total receipts were £226,013 (or £14,912 over 1904-5), whilst the working expenses amounted to £144,195, leaving a gross profit of £81,818. The chief items of expenditure were: Wages of traffic employés, £45,429; rates and taxes, £7,345; accident expenses, £3,359; repairs and maintenance of cars, £11,294; ditto of track, £4,936; overhead equipment, £2,830; cost of current for working cars, £48,574; other expenses, £10,907. The following items were chargeable against gross profit: Interest and sinking fund, £40,693; rental payments to other authorities for running facilities, £18,893; leaving a net balance, £22,303, which will be disposed of as follows: Contribution towards relief of the rates, £13,000; to depreciation and renewals fund, £9,302. The tramways have now contributed to the relief of the rates since the Corporation took over the lines a sum of £48,000, and the Committee has placed a sum of £30,439 to the credit of a depreciation and renewals fund. In consequence of a recent decision with regard to the purchase of the Swinton tramways and other matters, the Committee this year will have to face several additional items of expenditure.

Sheffield.—A Corporation tramway conductor has been suspended from duty because he refuses to remove the trade union badge from his uniform. Permission to wear the badge had not been obtained.

South Africa.—Durban.—The receipts of the Corporation tramways during March amounted to £7,096, a decrease of £162 over the corresponding period of 1905. The car-miles run were 106,454 as against 92,269, the revenue being 15·9d. this year, and 18·88d. last year.

Sunderland.—The Sunderland District Tramways Co., who own about 13 miles of tramways in the colliery districts outside Sunderland, started on Monday last a system of collection, carriage, and delivery of parcels. It is expected that special parcel cars will be required.

TELEGRAPH and TELEPHONE NOTES.

Brighton.—The L.G.B. inquiry on the subject of further borrowing by the Corporation for telephone purposes has been postponed to a date not yet stated.

Egypt.—The annual report for 1905 of H.M. Agent and Consul-General at Cairo states that, in the course of last year, 457 new telephone lines were opened in the provinces, thus bringing the total number of lines now working in Upper and Lower Egypt to 1,036; 850 more lines are in course of construction, and it is hoped will be completed in the course of the current year. The telephonic system has still to be extended to three provinces, namely, Ghirgeh, Keneh, and Assouan.—*Board of Trade Journal.*

New Cable Steamer.—The fleet of the Eastern Telegraph Co., Ltd., has been increased by the launch on Saturday last of the cable steamer *Sentinel*, at Paisley. The vessel is designed and equipped for work of a special character. A cable steamer for the Western Telegraph Co. will be launched at Paisley in a few days.

Swansea.—The Corporation Telephones Committee has decided not to continue negotiations with the Postmaster-General for the sale of the telephone system, after the communication from the latter that he will not negotiate on the basis of recouping the Council for the whole of the capital expenditure without depreciation.—*Western Mail.*

This is merely putting off the evil day; the Council's attitude is absurd. We refer to the matter in our leading columns.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1.)	Aug. 26, 1901	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Reissa-Issa (Yemen) Camaran	Oct. 25, 1902	
Cayenne-Pinheiro	Aug. 18, 1902	
Port Arthur-Chifu (Closed)	Mar. 7, 1904	
Tarifa-Tangier	Jan. 18, 1904	
Tangier-Cadiz	Feb. 18, 1906	
Cayenne-Paramaribo	April 20, 1906	
Sydney-Nelson	April 26, 1906	
Cap Haitien-Puerto Plata	May 15, 1906	
Landlines.		
Puerto-Barrios	Aug. 28, 1902	
Bachkale-Deliman	Feb. 12, 1906	

Underground Telegraph Cables.—Sir Edward Fithian, the secretary of the Association of Chambers of Commerce of the United Kingdom, has received a letter in reply to a memorial to the Postmaster-General in favour of laying all trunk wires underground, to the effect that the underground line between London and Glasgow has now been completed. The spur line to Manchester has been continued through Bradford to Leeds. In the south an underground line has been laid from London eastwards as far as Chatham, and westwards as far as Slough, and thence a pipe, but not yet a cable, as far as Reading. During the present year the Postmaster-General hopes to extend this pipe-line to Bristol and to provide a cable as far as Chippenham. The intention is to carry this line into Cornwall, to the landing places of important Atlantic and Mediterranean cables. The Postmaster-General adheres to the view that Parliament could not at present be asked to sanction a larger expenditure than that which is now contemplated, and that the Post Office could not proceed economically with greater rapidity than it is proceeding now.

Wireless Telegraphy.—For weeks past there have been rumours of some remarkable development in wireless telephony in Japan, and last week it was semi-officially stated that the Government had adopted a system of wireless telegraphy as a result of special investigations which had been in progress since 1900. The system decided upon was said to be unique and totally independent of any system in use elsewhere. "Dr. Kimura's wireless telephone is altogether different from the German in its principle." Whether the system is really one of telephony or one of telegraphy seems to be doubtful.

CONTRACTS OPEN and CLOSED.

OPEN.

Accrington.—May 22nd. Lancashire boiler and generating plant for the electrical engineering department. See "Official Notices" May 11th.

Bedford.—May 23rd. High and low tension cables for the Electricity Department. See "Official Notices" April 27th.

Belfast.—May 21st. Battery, boosters, balancers and switchgear for the Corporation. See "Official Notices" May 11th.

Bermondsey.—May 18th. Condenser, cooling tower, and arc lamp lowering gear. See "Official Notices" April 27th.

Birkenhead.—May 29th. Booster-balancer; switchboard extensions; and travelling crane for the Corporation electricity supply department. See "Official Notices" to-day.

Carlisle.—May 24th. Traction battery, reversible booster and motor-driven balancer, for the Electricity Committee. See "Official Notices" May 11th.

Clyde Navigation.—June 2nd. The Trustees invite tenders for the supply for one year of stores including:—Asbestos and packing; electrical stores; india-rubber. Specifications on application to the Superintendent of Stores.

Copenhagen.—June 7th and 9th. Cables and electric light meters for the Copenhagen Lighting Department. The conditions may be inspected at the offices of the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C. Copies of conditions may be obtained from the Director of Public Lighting, 22, Vestre Boulevard, Copenhagen.

Coventry.—May 24th. Lancashire boilers, economiser, piping, mechanical stoker, three alternators (two of 600-KW. and one of 300-KW.), and two-phase motors, for the Corporation. See "Official Notices" May 11th.

Dublin.—May 28th. Fire signalling apparatus, annunciator, switchboard, internal wiring and fire alarm bells, for the Waterworks Committee. Specifications, £1, from the City Architect, Municipal Buildings, Cork Hill.

Dublin.—May 28th. Sub-station switchboards and accessories; transformer pillars; for the Lighting Committee. See "Official Notices" to-day.

Fulham.—May 23rd. Sub-station equipment for the electricity department. See "Official Notices" May 11th.

Govan.—May 30th. Stores for the electricity department. See "Official Notices" April 20th.

Manchester.—May 23rd. Seven 150-KW. single-phase transformers, also sub-station switchboards, three-phase feeder cables, &c., for the Electricity Committee. Specifications from the Secretary, Electricity Department, Town Hall.

Mansfield.—May 30th. Battery and reversible booster; switchgear; for the Corporation. See "Official Notices" to-day.

Rotherham.—May 21st. Steel rails, fish-plates, tie-bars, trolley wire, bracket arms, &c., for the Tramways Committee. See "Official Notices" May 11th.

Spain.—June 4th. The municipal authorities of Zalamea La Real (Huelva province) are inviting tenders until June 4th for the concession for the electric lighting of the town during a period of 20 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Zalamea La Real.

Tenders have just been invited by the municipal authorities of Eibar (Guipuzcoa province) for the concession for the electric lighting of the town.

Stoke-upon-Trent.—May 20th. Steam dynamo, condensing plant, boosters and balancer, for the electricity department. See "Official Notices" April 27th.

Swansea.—May 29th. One 600-KW. C.C. steam generator with condensing plant, piping, &c., for the Corporation. See "Official Notices" May 4th.

Torquay.—June 1st. Condensing plant for electricity supply extensions. See "Official Notices" to-day.

Worthing.—May 28th. Gas engine and producer plant for the Corporation electricity works. See "Official Notices" May 11th.

CLOSED.

Glasgow.—The Tramways Committee has accepted the following offers:—

Armature pinions.—British Westinghouse Co.
Armature coils.—British Westinghouse Co.
Fuel for Pinkston power station.—Messrs. Baird & Co.; Summerlee Iron Co.; Robert Addie & Sons, Ltd.; James Dunlop & Co.; John Johnstone and Co.; and J. Johnstone & Boath.
Special work.—Lorain Steel Co.; Hadfield's Steel Foundry Co.
Lead-covered cable.—W. T. Glover & Co.; The National Conduit and Cable Co.
Slate slabs for switches.—Johnstons, Ltd.
Trolley wire.—Thos. Bolton & Sons.

Contracts for the year have been accepted as follows:—

Car axles.—Glasgow Railway Engineering Co., Ltd.
Car wheels.—J. Baker & Co., Ltd.
Car tires.—Brown, Bayley's Steel Works, Ltd.
Chilled iron castings.—Miller & Co., Ltd.
Carbons and carbon brushes.—Le Carbone.
Iron castings.—The British Hydraulic Foundry Co.; M'Dowall, Steven and Co.; and R. Howie & Co.
Malleable castings.—Tangyes, Ltd.
Steel castings.—Springfield Steel Co.
Engineers' furnishings.—William Landell.
Springs.—Geo. Turton, Platts & Co.
Tie-bars.—P. & R. Fleming & Co.; and Bayliss, Jones & Bayliss, Ltd.
Wrought-iron tubes and fittings.—Wilsons and Union Tube Co., Ltd.
Varnish.—James Aspin & Sons; and Tabor, Trego & Co., Ltd.
Cotton waste (white).—R. & W. Cuthbertson.
Iron and steel scrap for disposal.—P. & W. M'Lellan, Ltd; David Smith; Miller & Co., Ltd.
Upkeep of weighing machines.—W. & T. Avery, Ltd.
Rubber and asbestos goods.—Clyde Rubber Works Co., Ltd.; and Geo. M'Lellan & Co.
Oils.—Marks & Johnston; Hird, Hastie & Co.; and Dick & Parker.
Paints.—Hird, Hastie & Co.; Lewis Berger & Sons, Ltd.; and Strathclyde Paint Co.
Galvanised wire.—St. Helens Cable and Rubber Co.
India-rubber cable.—W. T. Glover & Co., Ltd.

Hereford.—The contract has been placed with Messrs. Pritchetts & Gold, Ltd., for 114 600-ampere-hour standard lighting cells for the Burghill Asylum, Hereford.

Hull.—The North-Eastern Railway Co. has accepted the tender of Veritys, Ltd., Newcastle, for their "Aston" interpole motors for the permanent way shops.

London.—WESTMINSTER.—The City Council has received the following tenders for the provision of arc lamps in the Great Smith Street first class swimming baths:—

E. Berry, Harrison & Co., (1) three 10-ampere lamps, £67; (2) six 6-ampere lamps £91 15s.
Coleby & Co., (1) £67 10s.; (2) £85 10s.
Leo Sunderland & Co., (1) £49 10s.; (2) (provisionally accepted) £84 10s.
Foote & Milne, (1) 8-ampere lamps, £66 10s.; (2) £95.
Westminster Engineering Co., (2) £54.

SHOREDITCH.—The B.C. has accepted the tender, at £200, of the Klein Engineering Co. for an automatic totalising coal weighing machine at the Whiston Street electric lighting station.

ISLINGTON.—The Lighting Committee has provisionally accepted the tender of the Electrical Co., Ltd., for the annual supply of meters.

L.C.C.—The Asylums Committee of the L.C.C. has received the following tenders for the establishment of telephones, fire alarms and tell-tale clocks at the Long Grove Asylum:—

Private Wire & Telephone Installation Co. ..	£1,495
Cox-Walkers .. .. (accepted)	1,715
Bromley, Batstone & Kirk	1,760
F. A. Glover & Co.	2,067
Strode & Co.	2,309

The lowest tender did not include £300 for contingencies, an omission which the company sought to rectify afterwards by increasing its offer to £1,795.

(*Continued on page* 807.)

THE WOOLWICH WORKS OF SIEMENS BROS. & CO., LTD.

THE above works were established in 1864 by the firm of Siemens Bros., of Westminster, to replace a small factory at Millbank Row, which had been started in 1858 by Mr. (afterwards Sir) William Siemens, for the manufacture of telegraph and other electrical apparatus. To keep step with the business of the firm, the works had to be continually enlarged; in the early seventies the manufacture of submarine cables was taken up, and about 1878 the firm commenced the construction of dynamo-electric machinery. In the year 1880 the firm was reconstituted as a limited liability company under its present title. The dynamo and motor branch of the business was recently transferred to Stafford, where extensive works were erected (ELECTRICAL REVIEW, August 19th and 26th, 1904).

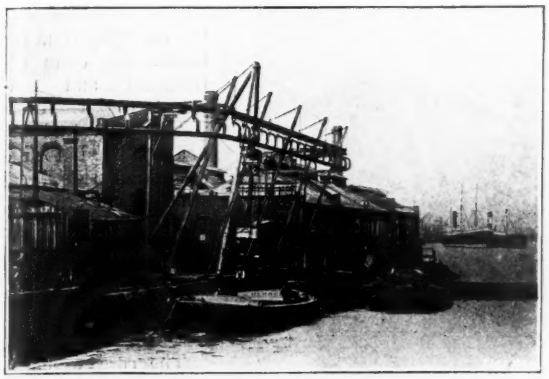


FIG. 1.—THE WHARF, SHOWING THE TELPHER TRANSPORT SYSTEM.

FIG. 2.—BIRD'S-EYE VIEW OF THE WOOLWICH WORKS.

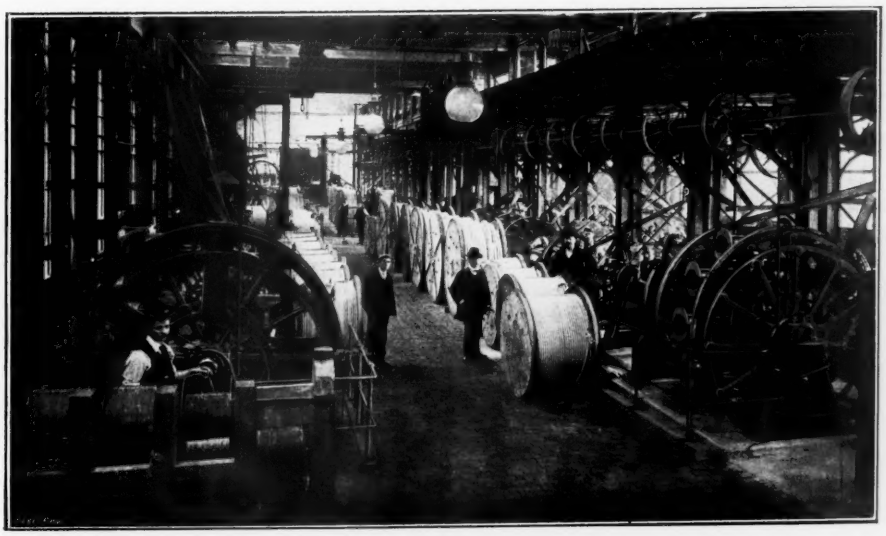


FIG. 3.—VIEW IN THE PAPER-INSULATED CABLE SHOPS.

The area covered by the Woolwich Works is now about 15 acres. A general view of them is shown in fig. 2. The north side is bounded by the Thames, and all the important shops and yards are traversed by a system of trolley lines running from east to west, whilst a telpher transport system runs from south to north between the Line Department and the wharf (fig. 1), the two systems allowing of an interchange of goods being effected. The works proper comprise submarine cable shops and tanks, railway signalling shop and electrical accessory stores on the north side of the main yard, the large shops for the manufacture of electrical apparatus occupying the first and second floors. On the south side are situated the power house and a large number of shops allotted to the many processes entailed in the manufacture of cables insulated with gutta-percha or india-rubber, whilst the top floors are utilised for meter and instrument testing, bobbin winding, and lacquering, &c. The whole of the eastern extension is taken up by the electric light and telephone cable shops (where paper forms the staple of the insulation) and the main office buildings, whilst the southern extension contains the Line Department, sawmills and joinery shops (a three-storey building), tinning, jute winding sheds and several store buildings. Electric transmission, by continuous current at low voltage carried to all parts of the works by underground mains, is adopted for driving tools separately or by countershafts, as found most convenient. All the shops are electrically lighted by Siemens arc and incandescent lamps, and are efficiently warmed by means of steam pipes.

Owing to the varied processes employed in these works it

is, of course, impossible in the short space at our disposal to do more than indicate the interesting features.

In connection with submarine cable, the copper wire from the store is delivered to the stranding shop, being then coiled on drums and transferred to the gutta-percha covering shop.

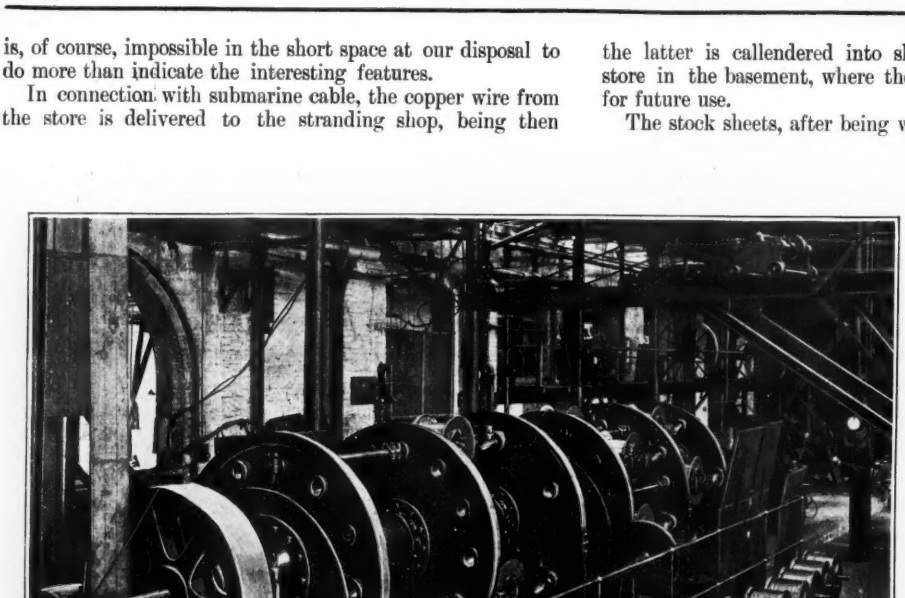


Fig. 4.—High Speed Covering Machine, for Sheathing Submarine Cables.

The first step in the manufacture of G.P. core is that of washing and masticating the raw gutta-percha, after which the latter is callendered into sheets and returned to the store in the basement, where the sheets are cut and stocked for future use.

The stock sheets, after being worked into the form of soft gutta-percha, are forced on to the stranded copper wire as it passes through a covering machine, as many as six cores being covered at one time on each machine. On emerging from the latter, the cores are hardened and subjected to a severe testing prior to being transferred to the sheathing shops, of which there are two, the older one containing about ten closing machines, and the other, one large high-speed machine, illustrated in fig. 4.

The core which is required to be sheathed, is led from the core tanks over sheaves through the machines, where it is armoured, compounded, covered with yarn or tape, according to the purpose for which it is required. At the end of each machine is a hauling-off gear provided with an indicator giving the revolutions of the hauling-off wheel, by which the length of cable is determined. The cable is delivered to a series of cable tanks prior to testing and storing on the cable ship.

Fig. 5.—View in the Lead-Press Shop.

The company owns the cable steamship *Faraday*, which has a gross registered tonnage of 4,917 tons. She is provided with three cable tanks, two of which are 45 ft. diameter by 30 ft. deep, the third being somewhat smaller. She has carried as much as 1,962 nautical miles of cable, of various types, the weight of this cable being about 4,500 tons.

The manufacture of vulcanised india-rubber wires and cables is carried out almost entirely in the older buildings situated at the south-west corner of the works. This process is, no doubt, familiar to the majority of our readers. Briefly, it embraces the tinning of the copper wires, which are then transferred to the bobbins of the stranding machines. After passing through these, the finished strands are wound on suitable drums for passing on to the I.R. covering machinery.

Each covering machine is capable of dealing with 1 to 12 wires at a time, according to the size of the strand to be covered. In the case of the ordinary vulcanised rubber cables a number of wires, with a continuous strip of pure rubber above and another below them, pass between a pair of grooved rollers, by the action of which the rubber is pressed round each wire. In order to remove the seams left between the contiguous wires, the latter are caused to pass over a separating roller. The wires then enter the next section of the machine, where a layer of white separation rubber is added in a similar manner; a third layer is afterwards superposed, and this constitutes the "jacket" of vulcanised rubber; the wires are then ready for the taping shop.

Fig. 6.—View in the Core-Testing Department.

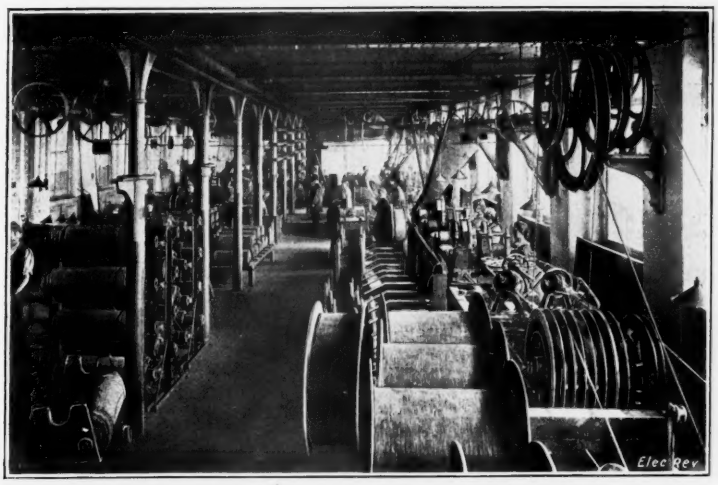


Fig. 7.—The India-Rubber Covering Shop.

Fig. 8.—View in the Instrument Shop.

From the latter the cable passes to cylindrical vulcanisers supplied with steam from the power station boilers. Each vulcaniser is fitted with two pressure gauges, one for the inner chamber and the other for the outer jacket, as well as to an instrument which continuously records the pressure and time on a paper drum. The vulcanising history of each coil is thus available for future reference at any time.

After being vulcanised, the cores are taken to the compounding shops; they are then measured into coils of standard lengths, tested under water, and stored ready for sale.

After passing through the compounding shop, certain classes of cable are sent to one of two braiding shops. The large braiding shop contains machines of different types suited to the various forms of cables and braiding required, such as yarn, wire or leather braiding, for ordinary, naval and mining work respectively.

The small braiding shop deals with silk and cotton-covered electric light flexible, bell and telephone wires, workshop and dynamo flexible, &c.

After braiding, the cables are again compounded, and after being electrically tested are dried and sent to the store. The various insulating tapes supplied by the company are also manufactured in the india-rubber department, where also the production of ebonite forms a section of the work.

Next to the main offices, and covering the whole of the east end of the yard, are the shops devoted to the manufacture of paper cables. Speaking broadly, the latter are divided into two classes:—(1) Telephone and telegraph cables; and (2) electric light and power cables.

The first shop on the ground floor is the paper stores. In the next shop are the machines for winding and measuring the copper wire, and also those which cut the paper into

strips of various widths and wind it into coils ready for use on the covering machines.

The bobbins wound with copper for electric light cable

Fig. 9.—The Wet Battery Shop.

are transferred to the large stranding shops next door, which are equipped with up-to-date machinery driven by electric motors, and where the copper wires are laid up and lapped with paper in one continuous operation, and coiled on drums. The latter are then taken to the lead press shops.

As regards the telephone cables, the first processes are covering and twinning. Each covering machine covers a single copper wire both longitudinally and spirally with insulating paper, in such a manner as to provide an envelope with an air space between the paper and the wire; the single cores then pass to twinning machines, where they are laid up in pairs, and, if necessary, covered again and duplicated to any desired extent. The cores or twins are covered by different coloured papers for purposes of identification.

In certain cases where it is desired to protect or "screen" the circuits from mutual induction when a number of telegraph wires are stranded in one cable, each core is lapped externally with copper tape. In the case of the large composite telephone and telegraph cables made for the Post Office, the various telephone cores are laid up in pairs and progressively combined to form the centre of the cable, and copper screened telegraph cores are laid round the outside.

It may be mentioned that Messrs. Siemens own the patents for the Dieselhorst-Martin cable.

Fig. 10.—The Dry Battery Shop.

As the cables come off the machines, they are wound on drums and transferred to the lead press shop, where they join the electric light cables, which have been already brought to the same stage of manufacture.

The lead press shop is shown in fig. 5. On the left are vacuum steam heaters and on the right, lead presses. Each drum of cable as it is brought from the stranding shops is transferred to one of the vacuum heaters, where it remains until all the moisture contained in the paper is extracted. The electric light cables are then plunged into tanks filled with insulating compound, where they remain until the compound has completely saturated the paper. The cable, after draining, is placed in another steam jacketed vessel, from which it passes into the lead presses to receive a lead envelope. The telephone cables are not subjected to the impregnating process, but are placed direct in the steam jacketed vessels and fed into the lead press. The object of the steam jacket is to prevent the cables from absorbing moisture between the time they leave the vacuum steam heater, and are covered with lead.

After leaving the presses, all cables which do not require iron sheathing or armouring are coiled on packing drums, and on these they are submitted to test in the tank house. After passing the required tests, the drums of cable are marked, and boarded-up ready for dispatch. Cables which require sheathing are taken to steel-band armouring machines, and wire armouring machines. They

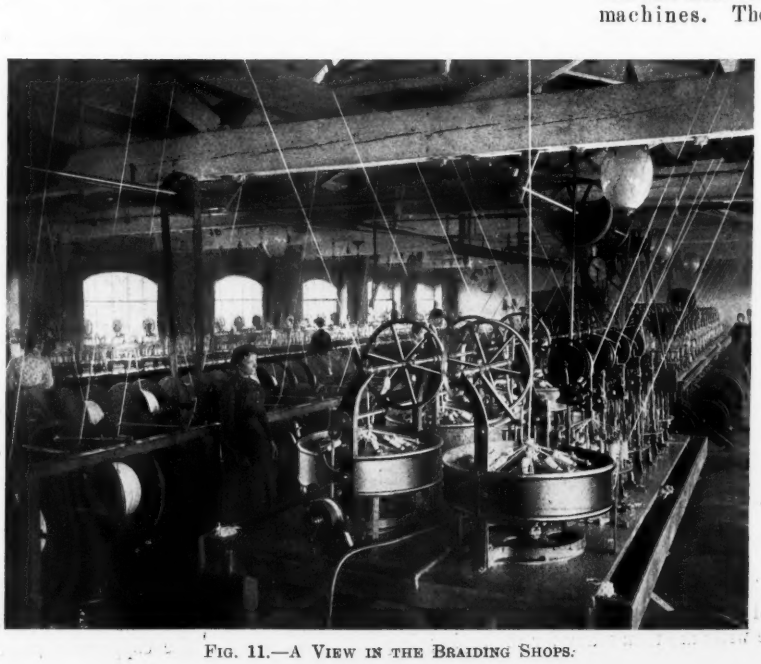


Fig. 11.—A View in the Braiding Shops.

are here sheathed, compounded, served with jute, whitewashed and coiled on the drums on which they are to be dispatched.

On the southern extension a large three-storey building with annexes has been erected for the wood-working department, which is devoted to joinery work and cabinet making, including the manufacture of cases for instruments, resistance boxes and condensers; also office fittings, furniture and telephone call boxes.

The small shops which were started in the original building for the manufacture of telegraph instruments have grown to such an extent, that they and the extensions which have from time to time been found necessary form a works in themselves. The work turned out is no longer restricted to instruments only, but includes articles up to the largest searchlight projectors. Here the small and finer work is done in connection with every class of electric light and telegraph instrument and apparatus, including switchboard and laboratory instruments, Morse sounders and inkers, Wheatstone transmitters, condensers, resistance boxes and galvanometers, &c., torpedo apparatus, searchlight projectors, &c. On the other side of the yard are several shops utilised for the various auxiliary processes in connection with instrument making.

On the north side is situated the railway signalling shop, in which the apparatus for the Siemens patent railway signalling system is manufactured; the switchboard shop and the electric light stores, in which are stocked large quantities of Tantalum lamps, Lilliput lamps, arc lamps, switches and small accessories of every description.

All the work connected with batteries, insulators, &c., is carried out in the Line department—a comparatively new series of shops erected on the southern extension of the estate. These comprise one long central shop used as a raw material and finished store, and a number of shops opening out of this on each side. The raw material is brought by telpher from the wharf or by carts from the railway into the store.

Situated centrally in the works is the power house. The steam is raised by five Laird gunboat type boilers and two Babcock & Wilcox boilers, arranged for the use of natural and induced draught. The generating plant comprises five 300-H.P. steam engines, direct coupled to Siemens continuous current shunt wound dynamos, each having an output of 1,500 amperes, 120 volts at 350 r.p.m. Three of the engines are of the Willans compound three-crank type, one of the Belliss enclosed three-crank compound type, and one of the Sisson compound two-crank type. All the dynamos are connected in parallel to the main bus-bars of the switchboard, which contains all the necessary controlling apparatus, indicating and registering instruments for 12 main circuits, which terminate in the distributing and controlling apparatus for lighting and driving the shops.

The works are provided with a fully-equipped chemical laboratory, in which samples of the various material in use are tested; there is also a suitably equipped engineering shop for carrying out local repairs in the works. The main offices consist of a three-storied building, in which are housed the clerical departments, manager's office, drawing offices, &c.

Power Station Economies and Electric Auxiliaries.

—An article on this subject in the *Engineering Magazine*, by Mr. Arthur S. Mann, advocates the use of steam at about atmospheric pressure, tapped off from the casing of a steam turbine, for heating feed water. Compared with a multiplicity of small reciprocating sets whose exhaust steam is used for heating the boiler feed, Mr. Mann's method is certainly superior. But because we are convinced that it is not the best method, we do not propose to quote or to examine his figures. Why should steam be used at all for heating the feed when it is remembered that that steam, no matter how near its pressure may be to the atmospheric, or what work it may have previously performed, represents coal burnt on the grates of the boiler furnaces? Has Mr. Mann no waste flue gases, or has he never heard of economisers, that he should ignore the use of these? We believe firmly in the value of electrically-driven auxiliaries, but we do not believe in advocating their use on a system which is only partially efficient, when a greater efficiency can be secured in another manner.

CONTRACTS CLOSED.

(*Concluded from page* 802.)

Ilford.—The U.D.C. has accepted the tender of Messrs. Norton Bros., of Ilford, for the erection of a steel chimney at the E.L. works, at £77.

Natal Government Railway.—Messrs. Bruce Peebles and Co., Ltd., have received from Messrs. Willans & Robinson an order for two 750-kw. 6,000-volt 3-phase turbo-alternators for the Natal Government Railway's new electric generating station at Durban.

Plymouth.—The Tramways Committee of the T.C. has accepted the tender of the Brush Electrical Engineering Co. for the supply of six demi-cars, at £501 each.

Willesden.—The U.D.C. has accepted the tender of Messrs. Geipel & Lange for the supply of arc lamp carbons for public street lighting, at £2 19s. 1d. per thousand pairs.

FORTHCOMING EVENTS.

To-day's Events (Friday, May 18th).—N.E. Coast Institution of Engineers and Shipbuilders. Closing business meeting, at Newcastle.
At 9 p.m. Royal Institution. Prof. A. Schuster on "International Science."

Saturday, May 19th.—At 3 p.m. Royal Institution. Prof. Sir J. Dewar on "The Old and New Chemistry." (Lecture I.)
At 7.30 p.m. Birmingham and District Electric Club. Mr. J. A. Jeckell on "Electricity Supply from the Commercial Standpoint."
Wednesday, May 23rd.—At 8 p.m. Society of Arts. "The General Supply of Electricity for Power and other Purposes," by Mr. J. N. Shoolbred.
Thursday, May 24th.—At 8 p.m. I.E.E. Annual General Meeting at the Society of Arts.
Friday, May 25th.—At 5 p.m. Physical Society. Mr. J. S. Don on "Colour Phenomena in Photometry"; Mr. H. Tomlinson and Rev. G. T. Johnston, "Exhibition of an Automatic Arc Lamp"; Prof. H. A. Wilson on "The Theory of Moving-Coil and other Kinds of Ballistic Galvanometers"; Mr. A. Campbell, "Exhibition of a Bifilar Galvanometer free from Zero Creep."
At 3 p.m. Royal Institution. Prof. Sir James Dewar on "The Old and the New Chemistry." (Lecture II.)
At 9 p.m. Royal Institution. Mr. L. Hill on "Compressed Air and its Physiological Effects."

THE ELECTRICAL ENGINEERS R.E. (VOLS.).

The following orders are issued:—

Monday, May 21st.—"A" Company, parade drill order (blue) 7 p.m., Cup competition; practice for Tournament, 9 p.m.
Tuesday, May 22nd.—"B" Company, practice for Tournament, 7 p.m.
Wednesday, May 23rd.—Detachments parade headquarters, 6.30 p.m., full dress, practice for Tournament.
Thursday, May 24th.—"C" Company, practice for Tournament, 7 p.m.
Friday, May 25th.—"D" Company, practice for Tournament, 7 p.m.
Saturday, May 26th.—Detachments parade headquarters in evening, and proceed to Olympia (time notified later).

J. H. S. Phillips, Captain.
For O.C.E.E.R.E. (V.).

NOTES.

Electricity Works and Tramways Statistics.—Our Annual Statistical Tables are now in preparation, and will be issued next month. In order to ensure the inclusion of all corrections, we shall be glad to receive any data-forms not yet returned, as soon as possible. Some of our kind collaborators, determined to include the very latest information, sometimes retain the forms until, alas! they are a little *too* late; to such we would say—Please send in without delay such particulars as are ready, and supplement them, if necessary, with final corrections as soon as the latter become available.

Electrical Volunteers at the Naval and Military Tournament.—An interesting and novel event at the coming Military Tournament will be the field searchlight display by the Electrical Engineers, R.E. (Volunteers). Two complete field sections will parade with engines, searchlights, and telephone parties, horsed and manned by members of the corps. The lights will be run out to positions in the Hall and connected up with the generating plant and run under as nearly service conditions as possible. A telephone party will meanwhile run lines from the various units, connecting the whole up to a field station. It is interesting to note that the apparatus which will be employed is that which was used by this corps in South Africa and at the Charing Cross disaster. This display will take place at Olympia on Saturday, May 26th, at the evening performance.

Institution Notes and Lectures.—I.E.E. (Birmingham Local Section).—The annual general meeting of the Local Section was held at the Grand Hotel on May 9th, 1906. The chairman (Mr. J. C. Vaudrey), in moving the adoption of the Committee's report, said that the members might congratulate themselves on the work of the past session. The papers had been well up to the average, and the meetings held at the technical school and at the new electrical laboratory of the university had been particularly instructive.

The officers and Committee for the next session were named in our issue of May 14th.

The report having been passed by the meeting, the chairman, on behalf of the members, made a presentation to Dr. D. K. Morris, the retiring hon. secretary.

Mr. Vaudrey said that Dr. Morris had been their secretary since the formation of the Section seven years ago. His resignation gave them the opportunity of making some recognition of the great service which Dr. Morris had rendered the Section during that time. Only those who had served on committee could fully appreciate the sacrifice of time and labour which the office involved, and the great debt of gratitude which they owed to Dr. Morris. Dr. Sumpner also spoke in high terms of the work which Dr. Morris had done for the Local Section, and expressed on behalf of the members the gratitude which they all felt. Dr. Morris made a suitable reply.

The meeting terminated with a vote of thanks to Mr. R. A. Chattock, who had arranged for the visit to the new power station of the Birmingham Corporation Electricity Department, in which the members had taken part that afternoon.

American Institute of Electrical Engineers.—A party of members of the A.I.E.E. will visit Italy in the middle of June, and at the end of the same month will take part in the general gathering in London of English and foreign electrical engineers.

Physical Society.—At the meeting held April 27th, 1906 (Dr. C. Chree, F.R.S., Vice-President, in the chair), Mr. W. B. Croft read a paper on "Some Simple Questions on the Images of Microscopes and Telescopes."

Mr. C. V. Boys gave a demonstration of the construction and action of his gas calorimeter, described in the *Proceedings of the Royal Society* for January, 1906. This is the instrument which is being used for testing the calorific value of London gas under the provisions of the London Gas Act, 1906.

Mr. J. Morrow read a paper "On the Lateral Vibration of Bars Subjected to Forces in the Direction of their Axes."

Six lectures on "Extra High Tension Cables" are to be delivered at the East London College, by Mr. J. T. Morris, commencing on Monday next. Some particulars appear in our advertisement pages.

Football.—Teams picked from the Glasgow Corporation telephone department and the General Electric Co., Ltd., played a friendly game at Myrtle Park on the evening of the 10th inst. The result was:—G.E.C., 2 goals; Corporation, 1 goal.

Anti-Municipal Evidence.—An irresponsible eye-witness sends us the following, which tallies well with what we have heard from other sources:—"During the progress of the London Power Bills inquiry in Committee last Thursday, Mr. Hammond, when under cross-examination, gave some strong evidence against municipal electrical undertakings. He stated that at Leeds the costs had considerably exceeded his estimate. Eight years ago, Mr. Hammond, in a paper on electrical costs, ventured upon the devious paths of prophecy. We fancy his advice to-day would be that of the man who said, 'Never prophesy until you know.' Mr. Tyldesley Jones endeavoured with some success to show that the costs at Leeds when the production was more than 5 million units had exceeded Mr. Hammond's prophetic figure for that output, and the witness was very properly annoyed at having cast up in his teeth these rash statements of his early youth. Witness admitted that he had learned a good deal during the eight years that had elapsed since he so rashly ventured on the above devious paths, but he excused himself on the ground that he had been right nevertheless, for the discrepancy in the costs as published in the *Electrical Times* (unkind to bring his own bantlings to crow on such an occasion) was due not to any failure in his prophetic vision, but to the awful fact that Leeds cooked its accounts. That the consulting engineer could admit that the great city of Leeds was guilty of false statements in its accounts was too much for counsel, who pretended to be shocked to such tune, that witness went out of his way to justify the cooking, which he clearly looked on as merely a sort of terminological inexactitude. You see, the cooking was one way only, like an underdone leg of mutton which a little more fire will put right, whereas an overdone leg is damned beyond recovery. So with Leeds the cooking was on the underdone side. But somehow the room didn't seem to take the easy view of municipal book-keeping entertained by the consulting engineer, and seemed anticipatorily sorry for Mr. Hammond next time he meets the Yorkshire cooks. A pious wish was expressed by counsel that what Mr. Hammond had learned in the past eight years would be as nothing to the knowledge he would acquire in the next eight. Counsel raised the boroughs of North London to confront witness like so many Banquo's ghosts. Had not witness advised separate little stations for various places against the claims of larger undertakings to supply in bulk, and was he not now endeavouring to sail on quite an opposite tack? Counsel kindly arranged questions that led witness to pose as a public benefactor. People had left and were leaving London, and the sympathetic L.C.C., under witness's direction, were sailing after them (not in Thames steamboats) to succour them and extend to them the privileges from which they had fled, including, as counsel hinted, the rates which they had tried to leave. So these benighted rats who had left the sinking ship were to be succoured at the expense of those who remained behind to be overwhelmed when the ship went down—altogether a telling bit of evidence against municipal trading, though somehow the witness seemed a bit cross about it all.

"One more curious fact was elicited, namely, that the carbonic acid gas that can be produced from a ton of coal in a municipal station to be built by the L.C.C. at Battersea will be two tons only. Ordinarily, of course, a ton of coal will give 3⅔ tons of CO_2, less, say, 5 to 10 per cent. for dirt, &c. Why should only 2 tons be got by the L.C.C.? There is some mystery here which witness did not explain, but even Nature's laws seem to go astray when a municipality is concerned. But surely if nothing worse than pure CO_2 was to be turned out of the chimney no one would have much to say against it. Counsel ought to have been better instructed on this point. But we left about here, for, as witness stated, there was a lot of it in the room, and he was right. But he gave municipalism a bad knock all the same."

The Tantalum Lamp.—In amplification of the information given in these columns a week ago, it is now stated that the General Electric Co., of New York, and the National Electric Lamp Co. have ratified the provisional agreement with the Siemens and Halske Co., by the payment of £50,000 for the right of manufacturing the tantalum lamp in the United States. The German company will also enjoy other advantages, inasmuch as it continues interested in the production of the lamp in New York. A sale price has been fixed, which will yield a satisfactory profit on each lamp. It is understood that before arriving at the arrangement in regard to the tantalum lamp, the American companies subjected all the newest types of lamps to tests in regard to the consumption of energy and the useful life, the choice falling finally upon the tantalum lamp.

L.G.B. Inquiries.—The Inspectors of the Local Government Board have earned the grateful respect of the British ratepayer, especially during recent years, by the care and acumen with which they have investigated the projects brought before them for the expenditure of public monies; in at least two cases lately (to which we refer in our leading columns) they have succeeded in exposing scandalous ignorance and mismanagement on the part of municipal trading departments. It is with regret, therefore, that we draw attention to two instances in which the Board's Inspectors, apparently acting upon instructions, have ventured upon expressions of opinion with regard to matters whereon they are not qualified to speak.

At Bridlington last month, Mr. H. R. Hooper conducted an inquiry into an application of the T.C. for leave to borrow £3,000 for electric lighting, including provision for street lighting. The Inspector stated that in all his experience he had found no light like that of incandescent gas lamps. This, no doubt, was true—in one sense; unfortunately he added that there was no light so good or so cheap!! Evidence was led to show that the town was saving £3,000 a year by the introduction of electricity for street lighting, double the light being given at less than half the price—from actual tests. We maintain that the Inspector's remarks were not only uncalled for, but absolutely unjustifiable. The second instance occurred at Newcastle on Tuesday last, when Mr. R. H. Bucknill was conducting an inquiry into an application of the T.C. for leave to borrow £4,500 for street lighting by electricity. Here, again, the objections of the L.G.B. to electrical street lighting were put forward, although the price to be charged was only £11 per arc lamp per annum. Having regard to the conditions under which electrical energy is generated for the supply of the arc lamps at Newcastle, it will be seen that this price should be easily attainable without loss to the tramway department. The general statement of the L.G.B. to the effect that electricity is more costly than gas for street lighting deserves the immediate attention of electrical men; under proper conditions there can be no doubt whatever that this statement is absolutely erroneous.

Manchester Tramways and Parcels Traffic.—At Wednesday's meeting of the City Council it was stated that the loss on the parcels carrying service instituted by the department in April, 1905, was £5,500 during the first year.

Electrical Installation at Sheerness.—The *Western Daily Mercury* says that the Admiralty have decided upon the strength of the staff to be employed at the generating station at Sheerness Dockyard when the plant for power and lighting is installed, as follows:—Station supervisor, B class (from 42s. to 49s. per week), 2; assistant drivers and dynamo attendants (28s. to 31s. 6d. per week), 3; apprentices or skilled labourers (at one-sixth the ordinary week rate per eight-hour shift, or from 28s. to 31s. 6d. per week), 2; leading stokers (31s. 6d. to 35s. per week), 2; stokers (24s. 6d. to 31s. 6d. for six days per week, and paid for overtime), 4 jointer (34s. to 42s. per week), 1.

Not an Electrical Fire at all.—In some of the daily papers it has been stated that the fire at Lord Derby's stables, Newmarket, was caused by the fusing of electric wires. Like most other similar reports, this proves to be incorrect. As a result of inquiries made by a responsible electrical official, it is found that the double-pole main switch was off at the time the fire originated; indeed, it was switched on and the light used to get the

horses out of the stables! It was then switched off again, and the distribution board and all fuses (for that part which has been burned down) were intact. Lord Derby's electrical engineer carried out the installation, and it has since been looked after by Messrs. Baily, Grundy & Barrett, of Cambridge and Newmarket. The Insurance Co.'s representative, after inspecting the switches and distributing boards (and seeing the man whose duty it is to look after the switching on and off who states that the electric light had not been used, as it had not been required for about three weeks) was quite satisfied that it was not due to electricity. Not all the gasmen and daily newspapers in the world could truthfully make this an electrical fire. But, nevertheless, the daily paper lie went to the public, and fed its prejudice against electricity. The contradiction ought to appear in big type in the same place.

Appointments Vacant.—Electrician for the Gold Coast Government Railway (£300); charge engineer for Southwark electricity works (45s.).

Mersey Railway Bill.—When this Bill came up for second reading in the House of Commons on Tuesday, Mr. Vivian moved its rejection because of the powers sought for running motor-omnibuses in Birkenhead. Mr. Roberts supported the rejection at the request of the Sheffield Corporation. This was negatived, and the Bill was read a second time, but, subsequently, by 199 votes to 108, the House decided to instruct the Committee to leave out Clause 5.

Röntgen Ray Burns.—It is reported that Dr. Holzknecht, of the Vienna General Hospital, has been ordered by the Court to pay £1,500 damages to a Vienna patient for injuries resulting from Röntgen ray treatment in 1902.

Fatality.—At Johannesburg on April 5th a boy of 12 years of age went to the electric meter at the back of the house, and finding the cover unlocked, put his hand inside; he touched live wires, and death ensued.

City and Guilds of London Institute: New O.S.A.—A general meeting of old students was held at the Technical College, Finsbury, on May 8th, Sir Owen Roberts presiding. About 120 old students attended to discuss the proposal to form an Old Students' Association. Mr. P. V. McMahon, M.I.C.E., M.I.E.E., &c., proposed "That an Old Students' Association be formed for (*a*) The Promotion of Social Intercourse; (*b*) The Advancements of the Interests of the Technical College and of Past Students; (*c*) Mutual Help." This was carried unanimously. It was further resolved that the draft scheme of the Organising Committee be provisionally adopted, and that it be an instruction to the Council to draw up a constitution and by-laws, and to submit them to a general meeting. A draft scheme was adopted. There will be one class of members only, and the subscription will be 5s. for London members and 2s. 6d. for country members. During the discussion Sir Owen Roberts said that he felt sure that various City companies would give financial support to the movement, and that he would put the matter before the Court of the Clothworkers' Co., which he represented. Dr. M. O. Forster, D.Sc., F.R.S., was elected President of the Association. The following officers were also elected:—Vice-Presidents, Sir Owen Roberts; Prof. J. Parry, D.Sc., F.R.S. Mr. P. V. McMahon is the electrical vice-president, Prof. W. E. Dalby is treasurer, and Mr. E. W. Moss is the electrical secretary. Five members from each department (electrical, mechanical and chemical) will serve on the Council, the electrical members being Messrs. A. C. Eborall, H. W. Handcock, H. B. Atkinson and F. H. Nalder.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Engineers.—The Morley T.C. has increased the salary of Mr. ELLIS, electrical engineer, from £200 to £225 per annum.

Mr. H. G. MCHAFFIE, resident electrical engineer to the Hoylake and West Kirby electricity works, has accepted an appointment with the Para Electric Railways and Lighting Co., Ltd., and he will sail for Brazil next month. His assistant, Mr. C. J. TURNER, has been appointed to the position which he is vacating at Hoylake.

Mr. J. P. KEMP has been appointed resident engineer at the Birmingham Corporation Summer Lane station at a salary of £300. Mr. F. FORREST has been appointed superintendent of sub-stations at £250. Three charge engineers have also been appointed to Summer Lane Works at £150 per annum each.

Mr. JAMES M. DAWSON, watch engineer at the Handsworth Corporation station, has been appointed, in public competition, one of the engineers-in-charge at the Hanley Electricity Works.

The staff of the Durban Corporation Electricity Department have inaugurated a lawn tennis club, of which Messrs. E. Poole, Woods, Brownell, Gyles and Thompson are the committee, with Mr. Poole as hon. sec. Mr. Councillor Hollander, chairman of the Electric Light Committee, formally declared the court open on April 7th, the borough electrical engineer (Mr. J. Roberts) forming the set for the opening game.

On April 14th Mr. T. C. H. ANDERSON, assistant mains engineer at Durban, entertained his fellow employés and friends to a "farewell" at the Corporation power station, and during the course of the proceedings was the recipient of a gold watch and case of pipes, presented to him by the acting borough electrical engineer (Mr. A. Taylor) on behalf of the staff of the Corporation Electricity Department, as a mark of esteem on his resigning the post he has held during the past three years. Mr. Anderson suitably responded, and a smoking concert followed.

Bailie P. G. STEWART, Councillor WILLOCK, and the chief engineer, Mr. W. W. LACKIE, are to attend the Municipal Electrical Association meetings in London on behalf of Glasgow in June. The chief engineer of Greenock will also be present at the conference.

Tramway Officials.—In consideration of services rendered in connection with the construction of the electric tramways, the Yarmouth T.C. has voted an honorarium of £500 to Mr. J. W. COCKERILL, the borough surveyor.

General.—On the occasion of his leaving to take up a position with Messrs. Cammell, Laird & Co., of Sheffield, Mr. L. H. CROWTHER, charge engineer of the Hull Corporation electric light and power station, was presented on Friday last by the clerical, engineering and works staff of the undertaking with a travelling bag and dressing case. In making the presentation on behalf of the whole staff, Mr. G. Sykes wished Mr. Crowther success in his new sphere, and incidentally touched upon the cordiality which had always existed between him and the works staff and members of the Electric Light Cricket Club, of which he was hon. sec.

Mr. PERCY J. TUNLEY, A.M.Inst.Mech.E., has resigned his position with Messrs. Johnson & Phillips, Ltd., Victoria Works, Old Charlton, S.E. Mr. Tunley has been chief draughtsman and latterly works manager and chief draughtsman of the above firm's electric light and power department, for the past 2½ years.

The *Morning Post* says that Capt. M. ST. L. SIMON, Royal Engineers, is to be appointed an Instructor in Electric Lighting with the Canadian Forces.

The Postmaster-General has appointed Mr. A. MOIR, first-class staff engineer at the General Post Office, to be Superintending Engineer of the Midland District of Ireland, in succession to Mr. H POMEROY, superannuated.

English scientists will be eager to congratulate Mme. CURIE upon the great honour that has been conferred upon her by the University of Paris, which has nominated her to the science professorship rendered vacant by the death of her husband. The Minister of Public Instruction has approved the choice.

Mr. NOEL L. GODBER, of the Westinghouse Co.'s publishing department, and formerly of the British Thomson-Houston Co.'s publication department, has been appointed acting editor of the *Engineering Times*.

NEW COMPANIES REGISTERED.

Auto Syndicate, Ltd. (88,652).—This company was registered on May 5th, with a capital of £10,000 in £1 shares, to acquire and turn to account certain patent rights known as "Auto-Mixte" (system Pieper), to promote companies, &c. The first subscribers (each with one share) are:—T. Bowing, 164, Salisbury House, London Wall, E.C., optician; W. A. Malcolm, 25, Mincing Lane, E.C., produce broker; L. Lewisson, 65, London Wall, E.C., clerk; R. H. Johnson, 115, Fleet Street, E.C., advertising agent; W. B. Smith, 117, East Dulwich Grove, S.E., clerk; H. Phillips, 44, Lawrie Park Road, Sydenham, S.E., clerk; and H. J. Veitch, 65, London Wall, E.C., chartered accountant. No initial public issue. W. Marshall is sole director and may retain office while holding 100 shares. Registered office, 30, Moorgate Street, E.C.

Phœnix Electric Heating Co., Ltd. (88,751).—This company was registered on May 12th, with a capital of £10,000 in £1 shares, to acquire the business carried on at 3, Holborn Place, W.C., as the "Electric Heating Co.," and to carry on the business of manufacturers of, dealers in and repairers of electric stoves and apparatus for heating, cooking and other purposes, electricians, founders, contractors, &c. The first subscribers (each with one share) are:—Mrs. L. Binko, 3, Holborn Place, W.C.; G. Offor, Park Hill Villa, Sydenham, S.E., director of the North Metropolitan Electrical Power Distributing Co., Ltd.; S. A. Sillem, The Cottage, Cranes Park, Surbiton, director of the Birkdale Electric Supply Co.: F. A. Donnison, A.I.E.E., 116, Great Portland Street, W., engineer; W. Sillem, 116, Great Portland Street, W., A.M.I.C.E.; F. W. Rushton, 245, Camberwell Road, S.E., clerk; and F. H. Brothers, 116, Highbury New Park, N., clerk. No initial public issue. The number of directors is not to be less than two or more than five; the first are F. A. Donnison, W. Sillem, S. A. Sillem, and two others to be nominated by Mrs. L. Binko; qualification (except nominees of Mrs. L. Binko), 500 shares: of such nominees, the holding of 500 shares by the said Mrs. L. Binko, for each director nominated. Remuneration as fixed by the company. Registered office, 3, Holborn Place, Holborn, W.C.

Percival Spencer, Ltd. (88,742).—This company was registered on May 11th, with a capital of £3,000 in £1 shares, to take over the business carried on by Spencer & Co., at 32, King Street West, Manchester, and to carry on the business of electrical, telegraph, telephone and general engineers, manufacturers and sellers of dynamos, motors, arc lamps, screws, bolts, nuts and cables, &c. The first subscribers (each with one share) are:—J. A. Hoyle, 48, Heald Place, Rusholme, Manchester, printer; J. Slater, 32, Park Place, Salford, confectioner; W. H. Crossley, 281, Dukinfield Road, Hyde, Cheshire, cashier; A. Cruise, 26, Pleasant Road, Eccles, bleacher; A. J. Jones, Nassau House, Eccles, engineer; H. E. Griffiths, 6, Royal Avenue, Old Trafford, Manchester, engineer; and F. M. Smith, 29, Wellington Street West, Higher Broughton, Manchester, accountant. No initial public issue. Table "A" is adopted. Secretary and registered office, F. M. Smith, 32, King Street West, Manchester.

Automixte, Ltd. (87,816).—This company was registered on March 3rd, with a capital of £1,000 in £1 shares, to carry on the business of motor-car, omnibus and vehicle proprietors and manufacturers, &c. The first subscribers (each with one share) are:—J. Neely, 60, Coleman Street, E.C., solicitor; J. H. Welfare, 16, Coleman Street, E.C., solicitor; F. E. Edwards (?), 9, Craddock Street, N.W., clerk; L. J. Welham, 3, Buckingham Road, Stratford, clerk; H. G. Hazelgrove, 15, Palace Road, Upper Norwood, clerk; R. F. Light, 92, Palatine Road, Stoke Newington, clerk; and E. W. Reilly, 16, Oliver Avenue, South Norwood, S.E., clerk. No initial public issue. Registered without articles of association.

Northern Electrical Supply Stores, Ltd. (88,725).—This company was registered on May 10th, with a capital of £1,000 in £1 shares, to acquire the business carried on at 92, Northumberland Street, Newcastle-on-Tyne, as the "Edison Supply Co.," to adopt an agreement with P. Hopper, trading under the above title, and to carry on the business of manufacturers of and dealers in electric lamps, bulbs, bells, batteries, dynamos, accumulators, and other electrical goods, suppliers of electric light, &c. The first subscribers (each with one share) are:—P. Hopper, 73, Church Hill, Walthamstow, manufacturer of electrical goods; Joseph Stanley Hopper, 1, Sylvan Avenue, Bowes Park, N., clerk; J. Frohwein, 273, Goswell Road, E.C., merchant; James Sydney Hopper, 1, Sylvan Avenue, Bowes Park, N., clerk; C. S. Philpot, 26, Ommaney Road, New Cross, S.E., clerk; C. W. Hopper, 17, Broadway Mansions, Winchmore Hill, N., clerk; and F. Frohwein, 273, Goswell Road, E.C., engineer. No initial public issue. The number of directors is not to be less than three or more than five; the first are not named. Registered office, 92, Northumberland Street, Newcastle-on-Tyne.

Dorchester Electric Light and Power Co., Ltd. (88,721).—This company was registered on May 10th, with a capital of £15,000 in £1 shares, to adopt an agreement with W. J. Fryer for the acquisition from the Mayor, Aldermen and Burgesses of Dorchester of a transfer of the Dorchester Electric Lighting Order, 1901, and any order amending or extending the same, and to carry on at Dorchester or elsewhere, the business of an electric lighting company in all its branches. The first subscribers (each with one share) are:—C. E. Woods, 56, Leighton Wood, Kensal Rise, accountant; G. S. Clarke, 48, Bravington Road, Harrow Road, W., clerk; R. W. Fryer, Sunnyholme, Taplow, contractor; F. A. Nyren, Isleworth, Maidenhead, manager; R. G. Chesher, 2, Farrant Street, Queen's Park, N., clerk; W. J. Gray, 61, Wornington Road, North Kensington, W., cabinet maker; and W. J. Fryer, 42, Sloane Square, S.W., engineer. No initial public issue. The subscribers are to appoint the first directors. Remuneration as fixed by the company.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Medical Electro-Vibration Institute, Ltd., Bradford (87,372).—A debenture, dated April 2nd, 1906, to secure £170, charged on the company's undertaking and property, present and future, including uncalled capital, has been registered. Holder: W. Harrison, 16, Nelson Street, Bradford.

Para Electric Railways and Lighting Co., Ltd. (85,368).—A trust deed, dated April 11th, 1906, to secure £700,000 first debenture stock, has been registered. Property charged: The company's undertaking and assets, with a covenant to execute a specific mortgage on its freehold property, buildings, &c., in Brazil, and its concession. Trustees: Anglo-American Debenture Corporation, Ltd., 20, Birchin Lane, E.C.

Arnold Goodwin & Son, Ltd., (81,663).—This company's annual return was filed on April 2nd, when 5,207 shares had been taken up out of a nominal capital of £10,000 in £1 shares. £207 has been received, and £5,000 is considered as paid. Mortgages and charges: £5,000.

City of London Electric Lighting Co., Ltd. (34,406).—This company's annual return, made up to March 28th, has been filed. 40,000 preference and 70,595 ordinary shares have been taken up out of a nominal capital of £1,200,000 in 40,000 preference and 80,000 ordinary shares of £10 each. £10 per share has been called up, resulting in the receipt of £1,105,950. Mortgages and charges: £800,000.

London Electric Wire Co., Ltd. (36,544).—This company's annual return was filed on March 5th, when 15,807 ordinary and 5,956 preference shares had been taken up out of a nominal capital of £150,000 in 30,000 ordinary and 10,000 6 per cent. preference shares of £5 each. £5 per share has been called up on 8,087 ordinary and 5,956 preference shares, resulting in the receipt of £70,215. £38,600 is considered as paid on 7,720 ordinary. Mortgages and charges: Nil.

George Moritz, Ltd. (38,158).—This company's annual return was filed on May 2nd, when 1,009 shares had been taken up out of a nominal capital of £5,000 in £1 shares. £9 has been received, and £1,000 is considered as paid. Mortgages and charges: £1,000.

Marconi's Wireless Telegraph Co., Ltd. (53,403).—This company's annual return was filed on April 26th, when 256,127 shares had been taken up out of a nominal capital of £500,000 in £1 shares. £1 per share has been called up on 191,127 shares, resulting in the receipt of £191,127. £65,000 is considered as paid on the remainder. Mortgages and charges: £25,000.

Körting Bros., Ltd. (78,308).—This company's annual return was filed on April 9th, when the entire capital of £50,000 in 10,000 shares of £5 each had been taken up. £1 10s. per share has been called up, resulting in the receipt of £15,000. Mortgages and charges: Nil.

National Telephone Co., Ltd. (15,066).—This company's annual return was filed on March 27th, when the entire capital of £6,000,000 in 15,000 first and 15,000 second preference shares of £10 each, 250,000 third preference and 90,000 ordinary shares of £5 each, £2,000,000 preferred stock and £2,000,000 deferred stock had been taken up. £10 per share has been called up on 12,220 first preference and 15,000 second preference and £5 per share on 221,716 third preference and 90,000 ordinary shares, and the full amount on £1,281,316 13s. 4d. preferred and £562,653 6s. 8d. deferred stock, and £3,674,760 has been received. £2,325,240 is considered as paid on 2,780 first and 28,284 third preference shares and £718,673 6s. 8d. preferred and £1,437,346 13s. 4d. deferred stock. Mortgages and charges: £3,698,593.

CITY NOTES.

Western Telegraph Co.

THE meeting of this company was held on Wednesday, at Electra House, Finsbury Pavement. Sir JOHN WOLFE BARRY, K.C.B., who presided, again congratulated shareholders upon the very satisfactory report (see the ELECTRICAL REVIEW, May 11th). The message revenue for the six months under review was nearly £47,000 more than in the corresponding half-year of 1904, and a most pleasing feature was that the improvement was general—all the countries in South America having contributed to the increased receipts. He was also glad to say that their receipts were maintained up to the present moment; but, as he remarked on the last occasion, they were now sharing in the general prosperity of South America, which in the past had gone through very critical periods, seriously affecting trade and commerce, and they must not forget that circumstances of a less satisfactory nature than at present existed might arise, though he had no wish to prophesy that such would be the case. The general expenses in London were more by £322, due to the ordinary augmentation of salaries and wages, and a small increase in the number of the staff. The expenditure at the stations showed a somewhat large increase of £7,575, and there again the most important item was salaries and wages. The increased traffic had, as a matter of course, entailed the employment of extra staff; but more than half the enhanced expenditure had been due to the higher value of Brazilian currency, the average rate being 16½d. per milrei, against 12¼d. in the latter half of 1904. The maintenance of landlines, electric instruments, &c., showed a decrease. In maintenance of cables there had been a net increase of £15,502. Their repairing vessel, the *Norseman*, had been engaged in effecting some extensive repairs to the older sections, and the cable used for that purpose cost them over £13,000 more than in the corresponding period. Smaller repairs and renewals of weak parts were being continued, but the money was well spent, and a marked improvement had ensued in the condition of several of the cables in shallow waters. The net result was that after providing £14,162 for debenture stock and debenture interest and sinking fund, and £4,978 for income-tax, there remained a balance of £149,516, to which had to be added a sum of £3,131 brought forward from June 30th, making a total of £152,648. First and second interim dividends, amounting to £62,379, had been paid, and after transferring £80,000 to the general reserve fund, and £5,000 to the maintenance of ships' reserve fund, there remained a balance of £5,269 to be carried forward to the next account. The shareholders were aware that the capital expenditure as shown in the balance-sheet, exceeded the issued capital by nearly £223,000, and that their reserves and debenture sinking fund were under-invested by over £410,000, the difference being accounted for by balances due to the bank, the value of cables and stores, remittances in transit, bills receivable, and cash in hand. As they had further capital expenditure in view in the shape of a new cable to St. Vincent and Cape Verd Islands *vid* the Azores, which would enable them to cope better with their increased traffic, the directors last month offered the share and debenture-holders the then unissued balance of 4 per cent. debenture stock, amounting to £230,620, with the gratifying result that the whole amount was taken up. A considerable portion of the sums paid on application and allotment had already been invested in high-class securities yielding a satisfactory rate of interest. At the last meeting he announced that Mr. Andrews had felt it necessary on account of ill-health to resign his seat on the board. He deeply regretted to have to inform them that Mr. Andrews died on the 4th inst., and he was sure the proprietors participated in the sorrow of the board at his loss. He had also to announce that Mr. St. John Brodrick, being no longer in the Ministry, had rejoined the board at the request of his colleagues.

Sir J. DENISON PENDER seconded the motion, and the report was adopted.

Eastern Extension, Australasia and China Telegraph Co.

THE half-yearly meeting was held on Wednesday, May 9th, at Electra House, Finsbury Pavement, Sir J. Wolfe Barry in the chair.

In proposing the adoption of the report (see ELECTRICAL REVIEW, May 4th), the CHAIRMAN first referred, in terms of sincere regret, to the death of Mr. W. S. Andrews. The gross revenue for the half-year under review amounted, in round numbers, to £317,000, against £332,000 for the corresponding period of 1904, showing a decrease of £15,000. This result was not due to any falling off in the traffic receipts, which, as a matter of fact, showed an increase, but owing to the revenue in 1904 having been exceptionally augmented by contract work and other special sources. The working and other expenses amounted, in round numbers, to £135,000, against £150,000 in the corresponding period of 1904, showing a decrease of £15,000, or a similar amount to the reduction in the revenue, and the one was a set-off against the other. The reduction in the expenditure was principally due to the repairs to their cables having been exceptionally few and unimportant during the past half-year, and to the credits for charter work in connection with the maintenance of cables for other telegraph administrations having been somewhat larger than usual. Comparing the figures for the whole of the year 1905, the result was as follows: The gross receipts amounted to £666,000, against £632,000 in 1904, showing an increase of £34,000. The ordinary expenditure was £271,000, against £291,000 in 1904, or a decrease of £20,000, due to the causes already mentioned. Consequently the company's financial position for 1905 showed an improvement over the previous year to the extent of £54,000. The net profit for the past half-year was £163,982, and after adding to it the credit balance of £42,081 brought forward from the previous half-year there remained an available balance of £206,063. The usual quarterly interim dividends of 2s. 6d. per share were paid during the past year, and it was now proposed to distribute a final dividend for the year of like amount, making a total dividend of 5 per cent. In addition a bonus of 4s. per share would be paid, making a total distribution for 1905 of 7 per cent. They had also been able out of the profits for the past year to place £150,000 to the general reserve fund (£100,000 for the June half-year, and £50,000 for the December half-year), and to carry forward £21,000. The whole of their extensive cable system was in good working order, except the two cables between New Zealand and Australia which, at present, were both interrupted, the duplicate cable possibly by volcanic action. This had necessitated the transmission by the British Pacific Cable of the traffic between New Zealand and Australia. Their cs. *Recorder* had been dispatched

from Singapore to effect repairs, and it was expected that communication would be restored by the end of next week. Since he last had the pleasure of addressing them, statements had appeared in the newspapers in reference to a pooling agreement between the Pacific Cable Board and the company, and to other important negotiations in connection with the company's position in Australia. As the statements were somewhat meagre and obscure, he proposed to supplement them by giving the shareholders a little additional information on the subject. It would probably be remembered that shortly before federation was established in Australia, the company entered into agreements with certain of the State Governments by which, in consideration of most important additions both physically and otherwise to the telegraphic facilities of Australasia, they secured the right, practically in perpetuity, to collect and deliver telegrams direct from and to the public in Adelaide, Sydney, Perth and Hobart, and to transmit such telegrams in Australia without the intermediary of the Government offices. This principle had long been recognised in this country as being of importance to the full development of cable telegraphy, and was applied to foreign, as well as British telegraph companies. The same arrangement was agreed to by the Victorian Government, but the agreement had not been signed when the Pacific cable was opened for traffic. Serious opposition was raised on behalf of the British Pacific cable to their exercising those rights in Melbourne, and soon after the Commonwealth was established the Prime Minister (Sir Edmund Barton) entered into negotiations with them, which resulted in an agreement being signed in 1903 enabling the Government under certain conditions to give notice after 10 years for determining them in the four State capitals and, at the same time, extending the principle of direct dealings with the public to Melbourne and Brisbane, so as to put all the State capitals of Australia on the same footing. The agreement was made subject to approval by the Federal Parliament, pending which approval the company was allowed to tentatively open public offices in Melbourne, and given the use of a special wire on the Government line between Adelaide and Melbourne, and this arrangement had been in operation for the last three years. The agreement was promptly approved by the Federal House of Representatives without a division, but the Senate delayed coming to a decision in order that a conference of the Pacific cable partners might first be held to consider certain questions which had been raised in connection with the company's agreements with the State Governments. After several postponements the conference was eventually held last summer, and its conclusions were embodied in a Parliamentary paper issued shortly afterwards. One of the conclusions favoured an arrangement being come to between the rival interests, and the basis of a pooling agreement was subsequently discussed and practically arranged between the Pacific Cable Board and the company, but it was not favourably entertained by all the Governments concerned, and the proposal had apparently fallen through. In December last the Senate again considered the agreement of 1903 negotiated by Sir Edmund Barton and approved it, subject to the company accepting an amendment which, in the opinion of the directors, most materially altered the intentions of the parties; consequently the company had no alternative but to reject the amendment, and thus terminate the agreement. The Government had now put an end to the tentative arrangement by closing their public offices in Melbourne, thus debarring the mercantile community in that city from the advantages enjoyed by the telegraphing public of Sydney, Adelaide and Perth, where their direct dealings with the public continued in accordance with their agreements, and were much appreciated. He was glad to say that most of the Melbourne merchants were marking their telegrams "*vid* Eastern" and they were, therefore, in accordance with the rules of the International Telegraph Convention, loyally handed over by the Government to their Adelaide office for transmission by their route, and no delays were apparently being experienced. He believed, however, that the Melbourne merchants were not pleased at being placed in a less favourable position than that occupied by the mercantile firms of Adelaide, Sydney and Perth, as most business men preferred to deal directly with a commercial organisation, such as theirs, rather than with a department of Government, however enlightened and efficient it might be.

The Marquis of TWEEDDALE seconded the motion, and the report was adopted.

Elmore's German and Austro-Hungarian Metal Co.

MR. J. MCFARLAN presided at the offices of the company, Finsbury House, Blomfield Street, on Thursday, May 10th, at the annual general meeting. In moving the adoption of the report (see ELECTRICAL REVIEW, May 4th) he said that beyond the re-arrangement of capital the figures in the accounts were practically the same as last year. It was, however, important to know that the assets of the company had been written down to a reasonable figure, and although the burden had fallen upon the shoulders of the ordinary shareholders, such burden inflicted not the slightest loss upon them. In the profit and loss account, again, the figures were almost identical with those of the previous year; the main item was, of course, £6,615 debenture interest, while the small profit of £176 was carried forward. He feared that the result of the trading for the year was disappointing, although to the directors they showed a great advance upon anything yet done by the Metall Co. The profit on trading was the largest ever yet made, and when one took into consideration the universal tendency towards cheapness in the finished article, the high price of raw materials, and universal tendency of the workmen to obtain the highest possible wage, they must congratulate themselves upon the steady increase in the gross profit they had shown not only for the year 1905 but for some years past. The charges incurred during the year were the highest they had ever been called upon to pay. Owing to the improved trade throughout Germany, they found that if they were to retain the number of workmen required they must increase the rate of pay; it was not the least of their difficulties to obtain the requisite number of workmen owing to the dearth of labour existing in Germany. There had been a considerable saving in the cost of repairs and maintenance of machinery and plant. The general expenses showed a great increase over that of the previous year, but they included items which they believed would not occur again. There had been an increase in the liabilities of the company on bills payable and sundry creditors, amounting to over £3,500, which was due entirely to the big increase in the price of copper, although they had on the other side not taken any advantage of such increase when valuing the copper stock. During the past year they were occupied in experimenting with their piercing machine, in order to ascertain the best possible method of working at the lowest possible cost, and the result was that they had been successful in their efforts, and had reached a lower point in the cost of production than any hitherto obtained. Now that, as far as they could see, all extraordinary expenditure had come to an end, they might look forward to a period of prosperity after the many unfavourable years through which they had passed. He had hoped that day he would have been in a position to tell them that certain contemplated financial arrangements referred to at the meeting held last November were completed, but, unfortunately, he could not do so. In order to satisfy their friends as to the value of the assets of the company, they had had two valuations made, one as to the value of the land, buildings and water-power, and the other as to the value of the plant and machinery. The valuation of the land, buildings and water-power was made by an official valuer on behalf of the group who proposed to advance money to the company. He made a very conservative estimate, and one to many of the items of which they demurred, but, notwithstanding, his valuation was nearly double the amount shown in their books. At the moment he did not want to go into particulars of the proposals, but they saw no reason why they should not go through, and in that event the position of the Austrian company was modified to a very great extent to the benefit of the shareholders, both preference and ordinary. To sum up the position, he might say that the progress hitherto made by the Metall Co. had been well maintained, especially with reference to the production of specialities, which were purely "Elmore" productions. The value of these were now recognised everywhere in Germany, and he was glad to say they were beginning to be appreciated in this country.

Mr. J. NEAL seconded the motion, and the report was adopted.

Calcutta Electric Supply Corporation.

ON Thursday last week the annual meeting of this company was held at Salisbury House, E.C., Col. A. J. Filgate in the chair.

The CHAIRMAN, in moving the adoption of the report, said the progress of the year was very satisfactory. The capital expenditure was £498,277, an increase over the previous year of £73,744. The principal items of expenditure being £9,599 on freehold land and buildings; tools and machinery, £316,444; mains and laying down, £25,957; and electricity meters, £6,515. During the year they had spent a large sum on plant and machinery for the new stations at Howrah and Ulvadonga, and on a new 500-KW. steam set and stokers at Alipore. To their underground mains they had added 20 miles, and to the overhead 7 miles, making in all an extension during the year of 27 miles. There was every reason to believe that there would be a large demand in the future for new mains. The gross revenue for the year was £72,591, as compared with £60,243 in the previous year. During the year to meet increasing demands, a further issue of £20,000 shares of £5 each was made. The shares were issued at a premium of £1 10s. each. The total expenditure as shown in the revenue account amounted to £38,871, as compared with £30,744 in 1904. The net revenue for the year was £33,720, as against £29,499, an increase of £4,221. Adding to this the amount brought forward from last year, and deducting the interim dividend paid on November last and the other charges entered in the net revenue account there was left £24,983 to be dealt with. Of this they proposed to pay a dividend at the rate of 10½ per cent. per annum, making with the interim dividend 8½ per cent. for the year, leaving a balance of £4,649 to be carried forward. They had sold during the year 3,548,299 units, as compared with 2,760,457, an increase of 28½ per cent. Their working expenses, including provision for renewals, amounted to £38,871, against £29,499, being an increase of 14 per cent. Repairs and maintenance amounted to £15,000, a large part of which was accounted for by the fact that the mains became very damp in Calcutta, and, of course, quickly rotted and had to be constantly repaired. These items had caused the board considerable anxiety, and they endeavoured, as far as possible, to keep it down. He could not think otherwise than that the company was altogether in a very satisfactory position, and he trusted the shareholders thought so too.

Sir GUILFORD L. MOLESWORTH seconded the motion, and the report was adopted.

Callender's Cable and Construction Co.

THE annual meeting was held on Thursday last week at Hamilton House. Mr. HENRY DRAKE, in moving the adoption of the report (see ELECTRICAL REVIEW, May 4th), said that his last year's statement that the year would be a more prosperous one had been fulfilled,

their profits having increased by £22,028 over the previous year. The share capital reserve and machinery renewal account and debenture stock remained the same. Bills payable were £132,756, as against £87,448, liabilities and trade creditors were £95,348, as against £74,089 in the preceding year, which showed that a much larger business had been done. The property at Erith, after allowing for depreciation, £13,000, and transferring £1,709 worth of plant to Leigh, stood at £313,991. He need hardly enlarge upon the immense value of that to them, as their engineers were of the highest standing, and their certificate for that amount—£314,000—per Messrs. Branmell & Harris, secured them from any mistake through over-estimating, which they, of course, wished to avoid. Their goodwill and patents stood at nil. That meant that all sums which had been paid had been charged to profits, and although it stood at nil, that did not diminish the actual value. The stock in hand at Erith was £100,705, as against £115,480, and that was very satisfactory to them, for, although they were doing a large business, they managed to keep down the stock in hand. Contracts in hand and patterns accounted for an expenditure of £113,966, as compared with £98,251. Sundry debtors were £193,256, as against £184,909. The money retained by Corporations for the fulfilment of contracts was £115,323, as compared with £94,356 last year. That was a sore matter to them, for they got no interest for the money; however, they would not get the work unless they locked it up, so the only satisfaction to them was that they could afford to do it. Their cash at bank, and bills receivable, amounted to £59,759, as against £19,342, which was very satisfactory for it, showed that the accounts had been better looked after. Shares and investments in other companies amounted to £76,796, as against £57,913. That was a fluctuating quantity, because they were obliged to take shares for some of their work. The Anchor Cable Co. stood at £87,308, as against £86,137. The profit for the year, after deducting all charges on contracts and manufacturing accounts, amounted to £124,541, as compared with £94,163. The general expenses were £28,652, and other items of the account brought the figure up to £45,446, leaving a balance of £79,094 to carry down. Adding the amount from 1904, they had a total of £102,501, and after writing off the depreciation items mentioned, interest on debenture stock and preference dividend, there was a balance of £65,171. They proposed to pay 10 per cent. on the ordinary shares, free of income-tax—5s. of which was paid on November 1st, 1905, and 5s. would be paid on May 31st, 1906—and they were going to pay a bonus of 5s. per share on May 31st, leaving to be carried forward £38,921. That was the most satisfactory year they had had since the formation of the company.

Sir Fortescue Flannery seconded the motion, and the report was adopted.

West India and Panama Telegraph Co.

The directors' report for the half-year ended December 31st, 1905, says that the amount to credit of revenue is £28,032, against £27,136 for the corresponding half-year of 1904.

The expenses have been £23,232, against £21,422, leaving a balance of £4,800, to which is added £1,735 interest on investments, and £1,425 brought forward from last account, making a total of £7,960, with which it is proposed to deal as follows:—

Payment of 4s. per share on the first preference shares (being 2s. balance of arrears to June 30th, 1905, and 2s. on account of dividend to December 31st, 1905)	£6,913
Balance to current half-year's account	1,047
	£7,960

The traffic receipts show an increase of £1,080 as compared with those for the corresponding period. The cost of maintenance of cables amounted to £8,722, as compared with £6,375 for the corresponding period of 1904. During a part of that period the *Henry Holmes* was chartered to another company, and earned £4,050. The foregoing maintenance expenses are, however, exclusive of a further expenditure of £1,174, which has been charged to reserve, in respect of part of the cable used in renewals during the half-year under review. The directors regret to report that, in the early part of the year, several interruptions of the cables occurred, which were probably caused by earthquakes. In order to assist the company's steamer *Henry Holmes* in overtaking the exceptionally heavy work of restoring the broken cables, the directors decided to charter the cable steamer *Cambria*. She was accordingly dispatched to the West Indies on March 10th; and, having almost completed her work, she will shortly return to England. The annual subsidy of £400 paid by St. Vincent expired on March 31st, and has not been renewed. The subsidy granted by Grenada has been reduced from £1,000 to £600 per annum from April 1st.

The directors have elected Sir John Cameron Lamb, C.B., C.M.G., to a seat at the board.

Castner-Kellner Alkali Co.

Sir Wm. Mather presided at the annual meeting of this company, held at Cannon Street Hotel, on the 14th inst. In moving the adoption of the report and the payment of a dividend at the rate of 8 per cent. per annum for the six months, he said that their enterprise was on a still stronger foundation. Their debentures were being gradually reduced. The profit for the year covered the debenture stock seven times over. A large sum had this year been added to depreciation reserve, and a larger sum than last year was carried forward. They did not desire to add to the capital for further developments; these they had to provide for from the work done year by year. They were erecting on the Tyne a department which would enlarge very much their facilities in regard to a portion of their manufacture. It was a removal, in a sense, from Runcorn of a certain portion of their plant and a large addition to it on the banks of the Tyne. Fortunately, the opportunity of acquiring electric power at a very reasonable price on the banks of the Tyne came when they were casting about to see how far they would enlarge one of their departments at Runcorn, and they resolved, after investigating very closely the pros and cons., to remove a department from Runcorn and establish it on the banks of the Tyne, in order that they might have the advantage of power all ready for them without any further expenditure of their own. On the other hand, they saw a great advantage in that change, because it liberated a very large amount of horse-power which they could use for other branches of their manufacture which promised well for the future. The report was adopted. Mr. Gerald W. Balfour was elected a director of the company. The chairman has retired from the chairmanship for personal reasons. He said that he had been for ten years of his life in this concern, and seven of these had been the most strenuous in all his business career, and the strain had told upon his health.

Dudley, Stourbridge and District Electric Traction Co.

The annual meeting was held at Donington House on 10th inst., Mr. A. C. Miles presiding. He said they were doubtless gratified at the recommended increase of 2 per cent. in the dividend. The gross receipts were only slightly more than in 1904. The traffic receipts had increased by over £1,000 on the year; the operating expenses had been reduced by £2,000, and the cost of repairs, maintenance and administration was also lower. It was proposed to declare a dividend of 5 per cent. to carry forward £506, and place £2,100 to the reserve (sinking) fund. The capital account had been over-expended by £28,000, but this would be put in order as soon as the business permitted of the capital account being closed. This was over and above the amount owing to the Birmingham and Midland Co. for the Kinver Light Railway. Regarding the arbitration between the company and the Corporation of Dudley for the purchase by the latter of the tramways and light railways within the town, the total amount to be received would not be less than £650,000, and if the sanction of the Court was obtained to the purchase of the No. 5 Railway under light railway terms, a larger sum would come into the coffers of the company.

The report was adopted.

West Coast of America Telegraph Co.

Sir J. Denison Pender presided on Tuesday at the meeting held at Electra House, and in moving the adoption of the report, he said that they had had an increase of £8,471 in traffics as compared with last year, and that increase was not from any special political excitement or anything of that sort, but from quite genuine business right away through along the coast. The prospects for the year 1906 were good, the increase of last year not only being maintained, but increased. There was a small decrease (£161) shown in expenses, but it was not an actual decrease, because in the previous year they had two or three items of exceptional expenditure; the actual working expenses were increased, because they could not expect to carry this increased traffic with the same staff and the same accommodation. The repairs in 1905 had cost £12,338 against £9,203 in 1904. They had received one or two letters with regard to the payment of a dividend. They must not forget that they had put £10,000 to general reserve, and £2,000 to ship's maintenance reserve. The cables were 30 years old, the ship was 27 years old, and they could not expect to go on keeping a ship and cables of that age in thorough working order without considerable expenditure on them. If they looked at the capital expenditure, they would agree that they were right in strengthening the reserves. They would have £150,000 debenture debt and £20,000 income bonds to be provided for in 1917; that was to say, the income bonds had to be paid off and the debenture debt to be arranged for. He did not say that the debentures would require to be paid off entirely, but it would be very unwise to carry on that large debenture debt. They had against it a reserve at present of £26,185, including the ship's reserve of £6,000. That was not 10 per cent. of the capital and the debts. If they put away something like £10,000 a year for the next 11 years, they would have a reserve fund of something like £130,000 to meet liabilities of £170,000. That would be adequate, because they could deal with a small portion of the debentures. He did not see how directors doing their duty, could think of paying a dividend at the present time until the reserve fund had arrived at an amount which rendered the future of the company practically safe.

Sir A. J. Leppoc Cappel seconded the motion, and it was adopted.

Mexico Electric Tramways, Ltd.

The directors' report for 1905 says that the result of the company's operations for the year, after charging interest on the debentures of the Compania de Ferrocarriles del Distrito Federal de Mexico, and after payment of 3½ per cent. guaranteed on the share capital of that company, shows a net profit of the sum of $580,964.26, which, at the rate of exchange of 2s., gives the sum of £58,096 to be carried forward to the credit of the London profit and loss account. The interest received on the debentures of the Compania

de Ferrocarriles del Distrito Federal de Mexico ($4,000,000 of which is held by this company), and the dividend declared by the Compania de Ferrocarriles del Distrito Federal de Mexico on its share capital (all of which is held by this company) is then added, and after charging expenses and obligations, &c., against the same, a net balance is shown to the credit of profit and loss account of the sum of £64,575, which, added to the balance brought forward from last year of £14,625, gives the total sum of £79,200. Out of this sum, the usual dividend of 6 per cent. has been paid on the preference shares, amounting to £30,000, and £35,000 has been transferred to the reserve account, including provision for depreciation, leaving a balance of £14,200 to be carried forward to next year's account. In addition to the above £35,000, there has been transferred to the same account the sum of £15,000 standing in last year's balance-sheet to the credit of depreciation reserve account, thus making a total of £50,000 to the credit of reserve account, including provision for depreciation.

During the year progress has been made in several advantageous extensions to the system in and around Mexico, and a contract has been entered into with the Mexican Light and Power Co. to supply power through their water power installation on most advantageous terms to the company. The new installation to carry out the provisions under this contract will entail an expenditure of £50,000, and is expected to come into operation towards the end of this year. Further additions have been made to the company's equipment in cars, freight cars and funeral cars, involving an outlay of about £11,000. During the past year the chairman (Colonel Sir Chas. Euan-Smith) paid a visit of some duration to Mexico, and the outcome of this visit will, the board trusts, remove many of the difficulties which the company laboured under, and bring about a better understanding between their officials and the Government. The traffic shows a most gratifying increase:—

Year.	Passengers carried.	Gross earnings.
1899	22,423,527	$1,923,869.28
1900	26,663,888	$2,058,880.29
1901	26,709,225	$2,103,174.87
1902	31,132,030	$2,400,787.83
1903	36,478,584	$2,799,282.84
1904	42,602,194	$3,272,306.97
1905	47,746,001	$3,642,105.61

Dr. F. Rutherfoord Harris, M.P., has resigned his position as director of the company. The board has appointed the following additional directors, viz.:—The Hon. Maurice Raymond Gifford, C.M.G.; Henry Malcolm Hubbard, Esq.; and Henry Thomas McNeale, Esq.

Globe Telegraph and Trust Co.

The Marquis of Tweeddale presided on Tuesday at the annual meeting held at Electra House. In moving the adoption of the report, he said that the receipts after deducting expenses were £205,718, or £6,595 over last year. As they started with a less balance of £1,400, the actual increase was £5,181. The total dividend was 5½ per cent. for the year, and £4,499 was carried forward. That might appear to be a large figure, but in view of the fluctuations to which the receipts were liable, the directors believed that course would be the best for all concerned as it would tend to make a steady and regular dividend and add to the stability of the company. The revenue from the company's investments had received the full 6 per cent. dividend from the Anglo-American Co., in place of the 5½ per cent. paid last year. From the Direct U.S. Cables they had received £1,200 more than last year. The income from the Great Northern Telegraph Co. was the same in both 1904 and 1905. The Indo-European Telegraph Co., which for years had paid 10 per cent., had declared a special distribution of 3 per cent. That amount had added to this company's income the substantial sum of £3,500. They had also paid a similar sum for the year upon which the company had now entered. There was a small addition to the amount received from the Mackay Companies, which had paid 2 per cent. on common shares, against 1 per cent. in the previous year. He believed the report would be considered eminently satisfactory, and the profits for the present year were no less satisfactory. Their investments showed a surplus over cost of £639,000.

Sir Jas. Pender seconded, and the motion was carried.

The retiring director and auditors were re-elected.

Brisbane Electric Tramways Investment Co.—The report for 1905 states that the dividends on the shares held by the company amounted to £41,972, and there was a total to credit of revenue account of £44,720. The net balance available is £39,099. The directors propose to apply £500 to accidents insurance fund, and after paying the balance dividend on the preference shares, making 5 per cent., there remains £2,618 to be carried forward. The manager of the Brisbane Tramways Co., Ltd., states that the dengue fever epidemic, which lasted for nearly five months, had a most damaging effect upon business of all kinds. The second six months showed a decided improvement. The working of the tramways for the year showed the following results:—Total receipts, £128,973; expenditure, £82,359; leaving a net profit for the year of £46,614, to which must be added the amount brought forward from 1904—£2,908—leaving a balance of profit of £49,522. The Tramways Co. has placed to credit of a renewals fund £5,000; in payment of dividends on shares, £42,000; and £2,522 is carried forward.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a special settling day in and to grant a quotation to:—

Calcutta Electric Supply Corporation, Ltd.—Further issue of 20,000 shares of £5 each, £1 paid, Nos. 80,001 to 100,000.

The Committee has been asked to allow the following to be quoted in the Official List:—

National Telephone Co., Ltd.—Further issue of £225,000 6 per cent. preferred stock; and £225,000 deferred stock.

The Committee has appointed a special settling day as under:—

Wednesday, May 23rd.—Madras Electric Supply Corporation.—10,000 shares of £5 each, 10s. paid, Nos. 1 to 10,000.

And has ordered the undermentioned securities to be quoted in the Official List:—

Costa Rica Electric Light and Traction Co.—Further issue of £37,100 5 per cent. first debentures, Nos. 2,201 to 2,556 of £100 and 1,601 to 1,530 of £50 each.

Great Northern, Piccadilly and Brompton Railway Co.—£1,133,000 4 per cent. perpetual debenture stock, in lieu of Speyer Brothers' scrip certificates now quoted.

Peebles (Bruce) & Co.—Further issue of 10,000 6 per cent. cumulative preference shares of £5 each, fully paid, Nos. 40,001 to 50,000.

Havana Electricity Co.—The debenture-holders has been notified that arrangements have been made for placing the company in voluntary liquidation and for the payment off of the debentures at par on June 1st.

Lanarkshire Tramways Co.—It is proposed to raise 5,400 new shares of £10 each, it having been decided to proceed at once with the construction of the Cambuslang extension. It is expected that the line will be opened in August.

Buenos Ayres Electric Tramways Co. (1901).—The report for 1905 states that gross receipts amounted to £64,514, as compared with £34,309 in 1904. There is a net profit of £13,286, as compared with £3,942 in 1904. The traffics greatly increased during the year, and the ratio of working expenses to receipts considerably diminished. £10,000 has been absorbed in debenture interest, leaving £696 to be carried forward.

Northallerton Electric Co.—At a special meeting on 9th inst. it was resolved to write off £3,192 for depreciation of machinery and service mains, and formation expenses. This is equal to 14s. on each of the 4,561 shares allotted and paid up. A shareholder suggested that the preference shares should also be reduced, but not to the same extent as the ordinary.

Durham Collieries Electric Power Supply Co.—A meeting of this company was held on Tuesday at the offices, 13, Great St. Helen's Place; but a representative of the Electrical Review was informed that the proceedings were private. A request for a copy of the report was also refused.

Deeside and District Electric Supply Co.—The statutory meeting was held last week. It was stated that in the first quarter of the year there had been a decided improvement as compared with the corresponding period of the previous year, and that the company began with excellent prospects of continuing a sufficient supply of light to the consumers in the district at a fair margin of profit.

Wolverhampton and District Tramways Co.—At the annual meeting, held at Donington House last week, Mr. S. R. Blundstone, in moving the adoption of the report, said the profits were somewhat larger than in the previous year, but, in spite of this, the dividend would, unfortunately, be somewhat less. In 1904 only 9½ months' debenture interest was paid, whereas last year the full amount was paid. This accounted for a difference of £3,392. Depreciation in 1904 was charged after the profit and loss, and last year it was charged before. The traffic had been much better, owing to the through running which had recently been arranged. The report was adopted.

Submarine Cables Trust.—The Marquis of Tweeddale presided at the annual meeting held at Electra House on Tuesday. The revenue for the year showed an increase of £769 due to larger dividends received from one or two companies in which they held investments. The securities held showed, at market value, an appreciation of £200,000. The adoption of the report was seconded by Sir J. Denison Pender, and carried.

Electricity Supply Co. for Spain, Ltd.—Numbers are announced of 130 debenture bonds that have been drawn for repayment.

Cape Town Consolidated Tramways and Land Co.—At a meeting of debenture-holders on 8th inst., a resolution was passed sanctioning a provisional agreement which provides for the reconstruction of the company. An extraordinary general meeting followed, at which resolutions were passed for voluntary liquidation, with a view to reconstruction. At the end of last year the directors were without the funds necessary to pay the debenture interest, without any working capital, and they owed about £40,000. They had either to liquidate or reconstruct, and they rejected the former course. In any reconstruction scheme the debentures must first be dealt with.

MARKET QUOTATIONS.

Wednesday, May 16th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a ,, ,, ...	per ton	£30	..
a Bleaching powder	per ton	£5 10	..
a Bisulphide of Carbon	per ton	£18	..
a Borax	per ton	£15	..
a Benzole (90 %)	per gal.	10½d.	..
a ,, (50 %)	per gal.	10d.	..
a Copper Sulphate	per ton	£26	..
a Lead, Nitrate	per ton	£27	..
a ,, White Sugar..	per ton	£31	..
a ,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90 % at 160° C)	per gal.	5/6	..
a Potassium Bichromate, in casks	per lb.	8d.	..
a Potash, Caustic (75/80 %) ..	per ton	£20	..
a Potassium Cyanide	per lb.	7½d.	..
a Shellac	per cwt.	200/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a ,, Crystals	per ton	£3 5	..
a Sodium Bichromate, casks ..	per lb.	2½d.	..
a ,, Cyanide	per lb.	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots ..	per ton	£160	..
b ,, Wire, in ton lots ..	per ton	£191	..
b ,, Sheet, in ton lots ..	per ton	£177	..
b Babbitt's metal ingots	per ton	£43 to £140	..
c Brass (rolled metal 2/- to 12/) basis	per lb.	9¼d.	½d. inc.
c ,, Tube (brazed)	per lb.	10¼d.	..
c ,, ,, (solid drawn).. ..	per lb.	9⅝d.	..
c ,, Wire, basis	per lb.	9¼d.	½d. inc.
c Copper Tubes (brazed)	per lb.	11¼d.	..
c ,, ,, (solid drawn) ..	per lb.	11⅝d.	..
g Copper Bars (best selected) ..	per ton	£100	£2 inc.
g Copper Sheet	per ton	£100	£2 inc.
g ,, Rod	per ton	£100	£2 inc.
e ,, (Electrolytic) Bars ..	per ton	£92	..
e ,, ,, Sheets ..	per ton	£104	..
e ,, ,, Rod ..	per ton	£95	..
e ,, ,, H.C. Wire	per lb.	11d.	..
f Ebonite Rod	per lb.	3/3	..
,, Sheet	per lb.	3/-	..
n German Silver Wire	per lb.	1/7	..
h Gutta-percha, fine	per lb.	6/- to 7/-	..
h India-rubber, Para fine	per lb.	5/8½ to 5/4½	inc.
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	£0,7½	7½ inc.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g Lead, English Ingot	per ton	£17 12 6 to £17 15	27/6 inc.
g ,, ,, Sheet	per ton	£19 10 to £18 12 6	27/6 inc.
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot	£7 5	..
d Mica (in original cases) small ..	per lb.	6d. to 1/-	..
d ,, ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, ,, large ..	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/3	..
p ,, rolled bars & rods	per lb.	1/1½ to 1/3	..
p ,, ,, strip & sheet	per lb.	1/4	..
o Platinum	per oz.	91/6	..
Silicium Bronze Wire	per lb.	1/- to 1/1	..
Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
,, in bars		£15 to £40	..
Tin, Block (English)	per ton	nominal	..
n ,, Wire, Nos. 1 to 16	per lb.	2/6	5d. inc.
p White Anti-friction Metals—			
"White Ant" brand	per ton	£46 to £70	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j ,, 6 lea. Flax	per lb.	5½d.	..
j ,, 3 ply 10 lbs. Russian ..	per lb.	4½d.	..
j ,, 16 lbs. Russian, single ..	per lb.	4½d.	..
j ,, 180 lbs. Jute rove ..	per ton	£11	..
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£30 5	..

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, G.P. and Teleg. Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
j Walter H. Hindley & Co., Ltd.
k Morris Ashby, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.

The International Aluminium Convention.—It is announced in the monthly circular of the Basle Handels Bank that the convention of producers of aluminium, which nominally expires at the end of this year, has now been renewed beyond that period. It is also stated that experiments have led to the conclusion that aluminium used in combination with certain kinds of steel is suitable for the construction of cannon. The production of aluminium in 1905 was insufficient to meet the demand, and as a consequence the price advanced by about 50 per cent. As all the works which produce the metal are occupied in extending their plant, it is expected that the output will be considerably increased in 1907.

STOCKS AND SHARES

Wednesday Afternoon.

More cheerfulness characterises the Stock Markets this week. Easier money, the settlement of the Turkish *affaire*, and a little public buying have joined hands to create more general confidence all round the Stock Exchange. One of the most welcome signs of changed sentiments is to be seen in the Home Railway revival. Another, equally agreeable, is the decidedly better tone amongst Electric Lighting shares. That the speculative divisions have not been left out in the cold is shown by a fresh dramatic advance in Anglo-American Telegraph Deferred Stock.

With the advance in Home Rails, Metropolitan Consolidated has improved to 70½, and Districts to 26½, the latter a rise of 2½ points. Regarded intrinsically, District stock may be worth 7 without the 20, but in the present temper of the public, the advance in price may continue. Metropolitan is worth putting away for a long lock-up. Central London Deferred shed a point, but the other two Ordinary stocks of the company are rather better than the prices show. It is, however, quite evident that the Central London may suffer severely this summer by reason of the increased motor-omnibus competition. There is a fall of 1 in City and South London, reducing the price to 40. Baker Street and Waterloo Debenture changed hands at 94 on Tuesday. Attention is being directed to the 5 per cent. Profit-sharing Notes of the Underground Electric Railways of London, which fall due in 1908; the price has declined a shade to 96½ upon the question raised as to the security for this repayment.

Other traction issues are, as usual, somewhat irregular. Anglo-Argentine Tramways Ordinary were marked down 1⅛ to 7½, the deduction representing ⅛ less than the market valuation of the "rights." The new shares are quoted 2 premium. Belgrano Ordinary cased off ¼, while Calcutta Trams again rose ⅛ to 9½. British Electric Tractions advanced. A little business has been done in Metropolitan Electric Tramway issues, and the Deferred are 3s. 6d. Of the less familiar descriptions, Brisbane Preference have been wanted at a trifle over 4—they are 5 per cent. cumulative shares of £5 each, fully paid. Sunderland District Electric Tramways 5 per cent. Debentures are about 94⅜, and Birmingham and Midland 4½ per cent. Debenture stock is 102½.

Friends of Mr. George Westinghouse, chairman of the British Westinghouse Company, will find a very favourable account of that gentleman in "Frenzied Finance," the remarkable book lately written by Mr. Thomas W. Lawson, of Boston. Shareholders in the British Company, at all events, will read with possibly mixed feelings that "single-handed, Mr. Westinghouse conducted all his great enterprises on a plain, patriarchal basis, using their revenues for extensions, and depending on his faithful and well-satisfied stockholders for such further accessions of capital as the business might, in his judgment, need." There are moments when silence is indeed golden.

Electric Lighting shares at length give some faint indications of a vital spark being left in them. Three or four inquirers, who looked as though they might have buying orders, took the market by surprise, and the general tone of prices hardened up as if it had received a tonic. St. James' rose £1 to 10½, and Westminsters and Kensingtons, all at the same figure, are the fraction higher, while the wide quotations, customary in this department, effectually conceal the greater firmness which has crept over prices. The only weak spot is Urban Ordinary, the price drooping to 4½, and the Debenture lost a point. Metropolitans hardened to 8¾.

Sheer gambling has run up the price of Anglo-American Deferred stock to 26, a jump of 1⅜ on the week. It is said that even this figure is fully justified by the assets of the company representing such a value for the stock at a break-up price. There will be a bad fall presently, all the same, though the shortage of stock in the market favours the side of the bulls. Since there is over three million pounds of the stock in existence, the first sign of a break in the price will probably bring in a lot of stock, whose proprietors are only waiting to see how much higher the price can go before they realise. It is rather surprising that the price of the Ordinary stock has only risen a point to 68, replacing the loss of last week. Direct United States Cable shares have spurted £1 to 16½, in sympathy with the jump in Anglo "A," and upon expectations of a good increase in the dividend.

Other telegraphs are quiet. A point increase in Eastern Telegraph stock was promptly lost, and there is ⅛ fall in "China" shares. This brings the prices of the two into a line. Globe Ordinary have recovered from their slight weakness, and are 11¼. The company's meeting was held yesterday, and so were those of the Submarine Cables Trust and the West Coast of America Telegraph Companies. West India and Panama shares at 12s. 6d. have receded a little, and Great Northerns are £1 up.

In the telephone group, United River Plate Ordinary are ¼ better at 7½, and no alterations occurred in Oriental Ordinary and Preference upon the marking of both shares *ex* dividend. National Telephone Preferred advanced a point. Nothing appears to be known about the terms of the next issue.

Several of the manufacturing shares are dull. Both Aluminium Ordinary and 7 per cent. Preference lost 5s., although the "A" Preference have recovered the deducted 5s. dividend. A similar fall leaves British Insulated at 6½, and Cromptons are ⅛ off at 2½, while the debentures show a 1 per cent. rise. The 10s. loss in Callender's is accounted for by the 10s. dividend, but Henley's are also 10s. lower at 12½, without any reason of the same sort.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last four years.				Closing Quotations May 9th.	Closing Quotations May 16th.	Business done week ended May 16th, 1906.		Rise + or Fall —
			1902.	1903.	1904.	1905.			Highest	Lowest.	
17,700	African Direct Telegraph, 4 % Debs...	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3⅜— 4¼	3⅜— 4¼	..	..	..
155,600£	Do. do. 5 % Debs., Nos. 1 to 1,950 Red.	100	Nil	Nil	Nil	5 %	83 — 88	83 — 88	84	82	..
702,600	Anglo-American Telegraph	Stock	60/6	61s.	2½%	3½%	66 — 68	67 — 69	68½	68	+1
8,148,700	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5½%	6 %	114 —115	114 —115	115	114	..
8,148,700	Do. do. do. Deferred	Stock	1/-	2s.	Nil	½%	24 — 24½	25½— 26	26	23½	+1½
50,000	Anglo-Portuguese Tel., 5% Mort. Deb. Stock Red.	100	..	..	..	..	101 —103	101 —103	103	102½	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	8 %	..	7⅞— 8⅛	7⅞— 8⅛	..	..	..
1,932,856£	Commercial Cable Stlng. 500 year 4 % Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	96½— 98½	96½— 98½	98	97	..
16,000	Cuba Telegraph	10	6½%	10 %	5 %	5 %	8½— 9 xd	8½— 9	..	..	..
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	10 %	17 — 18 xd	17 — 18	..	..	..
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3⅜— 3⅝	3⅜— 3⅝	..	..	..
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8½— 9	8½— 9	..	..	..
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	100—103%	100 —103 %	..	..	..
60,710£	Direct United States Cable	20	3½%	3 %	3½%	3½%	15½— 15⅝	16½— 16⅝	16½	15½	+1
70,000	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,300, R.	100	4½%	4½%	4½%	4½%	101 —103	101 —103	..	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	142 —145	142 —145	144½	143	..
2,000,000	Do. 8½ % Pref. Stock	100	8½%	8½%	8½%	8½%	89 — 91	89 — 91	..	..	..
1,848,772	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	106 —108 xd	106 —108	107	..	..
800,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	14½— 15	14 — 14½	14⅜	14¼	— ⅛
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	105½—107¼	105½—107½	105½	..	..
800,000	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..
200,000£	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	100 —102 xd	100 —102	..	..	..
180,887	Globe Telegraph and Trust	10	£3	5½%	5⅝%	5½%	11 — 11½	11⅛— 11⅞	11¼	11	+ ⅛
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	14½— 15	14⅞— 15	15	14⅞	..
150,000	Great Northern Telegraph, of Copenhagen ..	10	12½%	15 %	24 %	24%	37 — 39	39 — 41	39⅛	38¼	+2
42,800	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	101 —103	101 —103	..	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	13 %	13 %	56 — 58	56 — 58	57½	57	..
251,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	1⅛— 1⅜	1⅛— 1⅜	..	..	..
72,680	Monte Video Telephone Co., Ltd. Ord.	1	3 %	3 %	4 %	..	1⅛— 1⅛ xd	1⅛— 1⅛	..	..	..
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	..	¾— 1 xd	¾— 1	..	..	..
1,933,333	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	108 —110	109 —111	110½	109	+1
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	5 %	108 —110	108 —110	108⅜	108	..
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	12 — 14	12 — 14	13¼	12½	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10 — 12	10 — 12	..	..	..
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅜— 5⅝	5⅜— 5⅝	5 13/16	5 7/16	..
2,000,000	Do. do. 5½ % Deb. Stock Red. ..	Stock	5½%	5½%	5½%	5½%	98 —100	98 —100	99	98⅛	..
1,689,598	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	104 —106	104 —106	105½	105	..
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6 %	6½%	6½%	7½%	1⅜— 1½ xd	1⅜— 1½ xd	28/9	..	..
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1½— 1⅝	1½— 1⅝ xd	26/-	..	..
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	..	4 %	99 —101	99 —101	100¾	..	..
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	100 —103	100 —103	..	..	..
11,839£	Reuter's	8	5 %	5 %	5 %	5 %§	7⅞— 7¾	7⅞— 7¾	7½	..	..
60,000	Telephone Co. of Egypt, 4½ % Deb. Red. ..	100	..	..	..	4½%	103 —106	103 —106	..	..	..
3,201	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	126 —129	126 —129	..	..	..
70,000	United River Plate Telephone	5	7 %	8 %	8 %	..	7 — 7⅛	7 — 7⅛	7½	..	..
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5⅜— 5⅝	5⅜— 5⅝	..	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	110 —112	110 —112	..	..	..
15,609£	West African Telegraph, Shares	10	2 %	4 %	4½%	4 %	9⅜— 10⅛	9⅜— 10⅛	..	..	..
80,088	W. Coast of America, 1 to 80,000 & 53,001 to 53,088	2½	Nil	Nil	Nil	Nil	⅜— ⅝	⅜— ⅝	..	..	..
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	4 %	4 %	4 %	4 %	100 —102	100 —103	..	..	+ ½
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980 ..	10	7 %	7 %	7 %	6 %	14 — 14½	14 — 14½	14 7/8	14 5/8	..
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	5 %	101 —103	101 —103	..	..	..
563,380	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	101 —103	101 —104	103	..	+ ⅛
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	⅜— ⅝	1/16— 1⅛	..	..	— 1/16
34,563	Do. do. 6 % Cum. 1st Pref.	10	7 %*	7 %*	6 %	5 %	8 — 8½	8 — 8½	8 5/16	8 1/16	..
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	6 — 7	6 — 7	6⅜	..	..
80,000£	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	101 —104	101 —104	..	..	..

* Including arrears.

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

170,000	Anglo-Argentine Trams, 260,008 to 430,007	5	..	..	8 %	8 %	8⅛— 8⅜	7 — 7⅛	8⅛	7 3/16	—1⅛
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	..	5 %	5 %	5½%	5⅝— 6⅛	5⅞— 6⅛	6 1/16	5 15/16	..
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	..	6 %	6 %	6 %	140 —143	140 —143	..	..	..
285,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	..	5 %	5 %	5 %	104 —106	104 —106	..	..	..
800,000	Babcock & Wilcox, 1 to 800,000	1	..	17 %	20 %	20 %	3⅞— 4	3⅞— 4	79/16	78/9	..
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	..	6 %	6 %	6 %	1⅛— 1⅜ xd	1⅛— 1⅜	..	..	..
38,000	British Aluminium, Ord., 2,001 to 40,000 ..	5	..	..	7 %	7 %	2⅜— 2⅝	2⅛— 2⅜	2 1/8	46/3	— ⅛
40,000	Do. do. 7 % Cum. Pref...	5	Nil	Nil	7 %	7 %	6 — 6½	5⅞— 6⅛	6⅛	6 1/16	— ⅛
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	6 %	6 %	5½— 5⅝	5⅞— 5⅞ xd	..	..	..
20,000	Do. do. 4 % Funding Certs. ..	5	..	..	4 %	4 %	3⅞— 4⅛	3⅞— 4⅛	82/6	80/-	..
800,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	102 —106	100 —104 xd	..	..	..
800,000	British Columbia E. Rail Def. Ord. Stock	100	..	6 %	6 %	6 %	116 —119 xd	116 —119	..	..	..
300,000	Do. 5 % Pref. Ord. Stock	100	..	5 %	5 %	5 %	109 —112	109 —112	..	..	..
115,000	Do. 5 % Cum. Perp. Pref. Stock	100	..	5 %	5 %	5 %	107 —110	107 —110	108¾	..	..
240,400	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	..	4½%	4½%	4½%	102 —104	102 —104	..	..	..
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	..	4½%	4½%	4½%	103 —106	103 —106	102½	..	..
133,301	British Electric Traction	10	8 %	6 %	6 %	..	6 — 7	6½— 7	6¾	6 13/16	+ ⅛
161,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %§	8⅞— 9⅛	9 — 9½	9⅛	9¼	+ ⅛
1,415,422£	Do. do. 5 % Perp. Deb. Stock	Stock	5 %	5 %	5 %	5 %	112 —115	113 —116	115	113	+1
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½%	4½%	93 — 95 xd	93 — 95	93½	..	..
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	8 %	6½— 7	6½— 6⅝	..	..	— ⅛
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅞— 6¼	5⅞— 6¼	..	..	..
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	104 —107	104 —107	..	..	..
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	..	4½%	4½%	4½%	96 — 98	96 — 98	..	..	..
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	..	6 %	Nil	..	1⅞— 2⅛	1⅞— 2⅛	..	..	..
1,016,853	Do. do. 4 % Mort. Deb. Stock ..	100	..	4 %	4 %	4 %	80 — 85	80 — 85	..	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	⅝— ¾	⅝— ¾	..	..	..
50,000	¶ Do. do. 6 % Cum. Pref. ..	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	2½%	⅝— ¾	⅝— ¾	..	..	..
150,000	Do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	6 %	1½— 2	1½— 2	..	..	..
125,000£	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	97 — 99	97 — 99	..	..	..
125,000£	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	84 — 86	84 — 86	..	..	..
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	..	3 %	4 %	3 %	3¼— 3½	3 — 3⅛	66/3	61/3	— ¼
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	..	6 %	6 %	6 %	5⅝— 5⅞	5⅝— 5⅞	5⅞	..	..
27,500	Do "B" do. 1 to 27,500	5	..	6 %	6 %	6 %	5 — 5⅛	5 — 5⅛	5⅛	..	..
317,700	Do. 5 % Deb. Stock	100	..	5 %	5 %	5 %	106 —108	106 —108	..	..	..
190,000	Do. 5 % 2nd Deb. Stock	100	..	5 %	5 %	5 %	102 —105	102 —105	104¼	..	..
105,000	Calcutta Trams., 1 to 105,000	5	..	6 %	8 %	8 %	9⅛— 9⅜	9⅛— 9⅜	9⅜	..	+ ⅛
32,610	Do. 105,001 to 137,610	5	..	..	..	8 %	8¾— 9	8⅞— 9	8 15/16	8 13/16	..
850,000	Do. 4½ % 1st Deb. Stock	100	..	4½%	4½%	4½%	106 —108	106 —108	108	..	..
85,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	15%	11 — 12	10⅛— 11⅛	11 1/16	11	— ⅛
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅞— 6	5⅞— 6	..	..	..
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	108½—110½	108½—110½	..	..	..
491,222	Cape E. Trams., 1 to 491,222	1	..	15 %	10 %	5 %§	⅝— ¾	⅝— ¾	..	..	..
450,000	Castner-Kellner Alkali, 1 to 450,000	1	..	4 %	4 %	6 %	1 7/16— 1 9/16	1 7/16— 1 9/16	23/1½	22/6	..
230,211	Do. do. 4½ % 1st Mort. Deb. Stock	100	..	4½%	4½%	4½%	95 —100	97 —102	100	..	+2
1,939,688	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	88 — 90	88 — 90	90	88	..
630,316	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	99 —101	99 —101	100⅜	99½	..
630,316	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	78 — 81	77 — 80	78⅛	77⅝	—1
1,480,000	City and South London Railway	Stock	3½%	2½%	2½%	1⅞%	40 — 42	39 — 41	40⅝	39	—1
85,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	2½%	2½%	..	2 1/16— 2 3/16	2 — 2⅛	41/3	..	— 1/16
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	96 — 99	97 — 100	97½	97	+1

period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends.
‖ And bonus of 10s. ¶ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued).*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(continued).*

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations May 9th.	Closing Quotations May 16th.	Business done week ended May 16th, 1906. Highest	Lowest.	Rise + or Fall−
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	..	10 %	..	1⅝ — 1⅞	1⅝ — 1⅞	..	..	..
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	..	6 %	6 %	6 %	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..	..
294,150	Do. do. 4½ % Deb. Stock	100	..	4½ %	4½ %	4½ %	104 —107	104 —107	..	..	..
60,000	Dublin United Trams. (1896), 1 to 60,000	10	..	5½ %	6 %	6 %	13⅜ — 14⅜	13⅜ — 14⅜	..	..	..
59,987	Do. 6 % Pref. between 1 and 60,000	10	..	6 %	6 %	6 %	14⅜ — 15⅜	14⅜ — 15⅜	..	..	..
63,400	Do. 4 % Debs.	100	..	4 %	4 %	4 %	99½ —100½	99½ —100½	..	..	..
800,000	Do. 3½ % "A" Debs.	100	..	3½ %	3½ %	3½ %	95 —100	97⅛ — 98⅛	..	..	+ ⅛
800,000	Do. 3½ % "B" Deb. Stock	100	..	3½ %	3½ %	3½ %	95 —100	94 — 96	..	..	−2½
99,261	Edison & Swan Utd., "A" shrs., £3 pd., 1 to 99,261	5	Nil	Nil	2½ §§	..	1¼ — 1⅜	1¼ — 1⅜	31/3	..	..
17,139	Do. "A" shares, 01—017,139	5	Nil	Nil	2½ §§	..	2½ — 3	2½ — 3	..	..	..
344,023‖	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	86 — 88	86 — 88	..	..	..
100,000‖	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	90 — 95	90 — 95	..	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	4 %	Nil	..	5/16 — 3/8	5/16 — 3/8	..	..	..
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	7 %	7 %	7 %	..	2 — 2⅛	2 — 2⅛	..	..	..
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	4 %	89 — 92	89 — 92	..	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	..	9⅞ — 9⅞	9⅞ — 9⅞	..	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	94 — 98	94 — 98	..	..	..
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	..	3 %	4 %	4 %	3½ — 3⅝	3½ — 3⅝	75/-	..	..
96,000	Greenwood & Batley 7 % Cum. Pref.	10	..	7 %	7 %	7 %	10½ — 11½	10½ — 11½	..	..	..
80,000	Do. do. 5 % Mort. Debs.	100	..	5 %	5 %	5 %	100 —101	100 —101	..	..	..
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	20 %	15 %	15 %	15%	12½ — 13½	12 — 13	..	..	− ½
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5½ — 5⅝	5⅛ — 5⅛	5⅛	..	..
41,978	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	109 —111	109 —111	..	..	..
108,022	Do. do. Scrip. 50 % paid	..	..	..	..	..	57½ — 59½	57½ — 59½	58½	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works.	10	10 %	10%	5 %	10%	17 — 18	17 — 18	..	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	1½%	12½%	1½%	Nil	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	5 %	6½ — 7	6½ — 7	..	..	..
600,070	London United Trams (1901), 1 to 50,007	10	..	8 %	6 %	3 %	7 — 9	8 — 8½	..	..	+ ½
399,980	Do. do. 60,008 to 100,000 (£4 paid)	10	..	8 %	6 %	3 %	1½ — 2½	2 — 3	..	..	+ ½
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	..	5 %	5 %	5 %	9⅛ — 9⅜	9⅛ — 9⅜	..	..	..
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	96 — 99	97 —100	99½	97½	+1
314,016	Metropolitan Electric Trams, Defd.	1	Nil	Nil	Nil	3 %	⅛ — ¼	⅛ — ¼	3/3	..	..
500,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	⅝ — 1	⅝ — 1	19/3	18/6	..
850,000	Do. 4½ % Deb. Stock Red.	100	..	..	4½%	4½%	102 —104	102 —104	103	..	..
20,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 40,000	5	..	..	6 %	6 %	5¼ — 5⅜	5 — 5¼	..	..	— ⅛
24,500	Potteries E. Trc., 20,001 to 40,000 & 50,001 to 54,500	10	..	5 %	5 %	4 %	8 — 9	8 — 9	..	..	..
24,500	Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500	10	..	5 %	5 %	5 %	8 — 9	8 — 9	..	..	..
245,000	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	103 — 106	101 —104 xd	..	..	..
37,350	Telegraph Construction and Maintenance	12	20 %	20 %	15 %	15 %	32 — 34	32 — 34	32¾	32	..
150,000‖	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	4 %	101 — 103	101 —103	..	..	..
8,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	..	5 %	5 %	96 — 98	96 — 97	96	95⅞	— ⅛
640,000	Waterloo & City Railway, Ord. Stock	100	3½%	3½%	3½%	3½%	99 — 102	99 —102	..	..	..
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	8½%	3 %	Nil	Nil	1⅜ — 2⅛	1⅜ — 2⅛	57/6	36/-	..
66,666	Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666	5	..	6 %	Nil	Nil	3 — 3⅛	3 — 3⅛	68/9	59/4½	..
246,806	Do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	80 — 85	80 — 85	..	..	..

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	5	..	5 %	5⅛%	4 %§	5⅛ — 5⅝	5⅛ — 5⅝	..	..	..
50,000	Do. do. 4½ % 1st. deb. stock	100	..	4½%	4½%	4½%	101 —104	101 —104	..	..	..
29,377	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	8 %	10 %	10 %	10 %	8½ — 9½	8½ — 9½	8⅛	..	..
10,623	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	8½ — 9½	8½ — 9½	..	..	..
300,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	102 —105	102 —105	..	..	..
80,000	Charing Cross and Strand Electricity Supply	5	10 %	8 %	8 %	5 %	4 — 5	4 — 5	..	..	..
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4⅜ — 4⅞	4⅜ — 4⅞	..	..	..
40,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	4 — 4½	4 — 4½	..	..	..
40,000	Do. do. 1903	5	..	4½%	4½%	4½%	4 — 4½	4 — 4½	..	..	..
420,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	101 —103	101 —103	102	..	..
44,486	Chelsea Electricity Supply, Ord.	5	4½%	5½%	6 %	6 %	5½ — 5⅝	5½ — 5⅝	..	..	..
175,000‖	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	107 —109	107 —109	..	..	..
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	5 %	6 %	6 %	10½ — 11	10⅝ — 11⅛	11	10⅞	+ ⅛
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	13 — 14	13 — 14	..	..	..
400,000‖	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	123 —126	123 —126	..	..	..
800,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	101 —103	101 —103	101⅜	..	..
40,000	County of Durham Electrical Power, Ord.	2	4 %	4 %	£3 7 0	4 %	2⅞ — 3⅛	2⅞ — 3⅛	..	..	..
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	5⅛	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4½%	5 %	8 — 9	8 — 9	8⅛	..	..
80,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	11¼ — 12¼	11¼ — 12¼	..	..	..
400,000‖	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	109 —112	109 —112	110⅜	..	..
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	99 —101	100 —102	10⅞	..	+1
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	5 %§	3⅜ — 4¼	3⅜ — 4¼	..	..	..
80,000	Do. do. 6 % Cum. Pref.	..	6 %	6 %	6 %	6 %	5 — 5⅛	4⅞ — 5⅛xd	5⅛	5	..
820,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	4½%	4½%	103 —106	103 —106	103	..	..
10,000	Folkestone, 1 to 10,000	5	..	5½%	5½%	5½%	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	..	5 %	5 — 5⅛	5 — 5⅛	..	..	..
75,000	Do. 4½ % 1st. Deb. Stock	100	..	4½%	4½%	4½%	101 —104	101 —104	..	..	..
18,000	Hove, 1 to 18,000	5	..	8½%	8½%	9 %	8¼ — 8⅝	8¼ — 8⅝	..	..	..
10,000	Do. New (£6 10s. paid)	£3	..	8½%	8½%	9 %	7 — 8	7 — 8	..	..	..
37,300	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	96 — 99 xd	96 — 99	..	..	..
7,300	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	96 — 99 xd	95 — 98	..	..	—1
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	12 %	12 %	10 %	9½ — 10½	10 — 11	..	..	+ ½
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	Nil	3 %	4 %	2 — 2½	2 — 2½	..	..	..
60,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	5 — 5½	5 — 5½	5½	..	..
874,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..
200,000	Metropolitan Electric Supply, 1 to 100,000	5	7½%	8⅜%	10 %	10 %	8 — 9	8½ — 9½	8⅝	8⅛	— ⅛
76,121	Do. 4½ % Cum. Pref. 1—71,106, £3 pd.	5	4½%	4½%	4½%	4½%	5⅛ — 5½	5⅜ — 5⅝	5½	5 1/16	+ ⅛
220,000‖	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	110 —114	110 —114	..	..	..
250,000‖	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	95 — 97	95 — 97	..	..	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	101 —103	101 —103	..	..	..
75,000	Newcastle-on-Tyne, 1 to 75,000	5	..	8 %	8 %	8 %	7⅛ — 7⅜	7⅛ — 7⅜	..	..	..
75,000	Do. 5 % Pref., 1 to 75,000	5	..	5%	5 %	5 %	6 — 6½	6 — 6½	..	..	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	7 %	7%	13 — 14	13 — 14	..	..	..
64,000	Do. do. 4 % 1st Mort.Deb.	100	4 %	4 %	4 %	4 %	97 — 99	97 — 99	..	..	..
18,500	Oxford, 1 to 96 and 407 to 18,810	5	..	6½%	7 %	7 %	6½ — 7	6½ — 7	..	..	..
50,000	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	99 —101	99 —101	..	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	12½%	9 — 10	10 — 11	10⅞	9⅞	+1
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	7 — 8	7 — 8	7⅞	..	..
150,000‖	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	96 — 98	96 — 98	..	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	2½%	4 %	4 %	4 %	2½ — 2⅝	2½ — 2⅝	..	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	76 — 80	76 — 80	..	..	..
65,000	South London Electricity Supply, Ord.	5	12½%	8 %	4 %	4 %	3 — 3½	3 — 3½	..	..	..
103,700	South Met. Elec. Lt. & Power (Ord.	1	Nil	Nil	Nil	2½%	⅜ — ½	⅜ — ½	..	..	..
85,368	*(Late Blackheath and Greenwich* 7 % Pref.	1	Nil	7 %	7 %	7 %	1⅛ — 1⅜	1⅛ — 1⅜	26/3	..	..
148,292	*Dist. E.L.Co.)* 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..
50,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	4⅛ — 4⅜	4 — 4⅛	..	..	— ⅛
80,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	4 1/16 — 5 1/16	4 1/16 — 5 1/16	98/1½	..	..
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	..	4½%	4½%	102 —104	101 —103	102	..	—1
110,000	Westminster Electric Supply, Ord.	5	12 %	15½%	14 %	13 %	9⅜ — 10⅛	10 — 11	10 3/8	10	+1
28,151	Do do. 4½ % Cum. Pref. (Originally 5 %—Red. to 4½ % from 31st Dec., 1905.)	5	5 %	5 %	5 %	5 %	5 1/16 — 5 1/16	5 1/16 — 5 1/16	5 1/32	..	..

Shares not officially quoted :—Mackay Companies, ord., 65—66. Pref. 76½—77½.

† Unless otherwise stated all shares are fully paid. § Interim dividends.

(Bank rate of discount 4 per cent. (May 3rd, 1906).

PROCEEDINGS OF INSTITUTIONS.

A New Single-phase Commutator Motor.

By V. A. Fynn, Member.

(*Abstract of Paper read before the* Institution of Electrical Engineers, *March 8th*, 1906.)

During the last few years quite a number of engineers have been engaged in an attempt to produce a single-phase motor which could compare with its continuous current rival. As the railway problem has been principally in mind, these efforts have been restricted to types possessing a series characteristic, and consequently to motors unsuitable for most of the stationary work. There exists, however, a great demand for a "constant speed" machine, with great starting torque and high power factor. The motor to be described in this paper can be built with either shunt or series characteristic; the former class has now been fully developed.

No description of a modern single-phase commutator motor can be complete without a reference to the pioneer work of Mr. Ll. B. Atkinson, who, in a masterly paper read in 1898 before the Institution of Civil Engineers, described those forms from which all the modern single-phase commutator motors are directly derived, and dwelt at length on their several advantages and peculiarities.

The fundamental form of the single-phase induction motor, as defined by Atkinson, is shown diagrammatically in fig. 1. The primary member is magnetised along an axis F by means of the winding S. The secondary member, which consists of an armature provided with a continuous current winding connected to a commutator, is short-circuited by means of the brushes C C and D D along two perpendicular axes, one of which coincides with the field axis of the primary member or stator. This diagram and all the following ones represent two-pole machines, while throughout the armature winding is supposed to be of the Gramme-ring type, with the brushes bearing directly on the armature winding; and hence the axis of a field which could be set up in the rotor by a current passing a set of brushes will coincide with the axis of that particular brush set.

Such a commutator motor has all the characteristics of the asynchronous single-phase squirrel-cage motor; in fact, the latter is only a special case of the former.

The motor in fig. 1 will not start; its power-factor is bad; it is very liable to spark at the commutator; and its output for a given weight is small.

Early recognising the possibilities of this type of motor, the author subsequently set himself the problem of evolving from it a new motor, in which the above defects would be, as far as possible, eliminated; and it is claimed that this problem may now be considered as having been satisfactorily solved.

The machine starts very well as a "repulsion motor." In fig. 7 is shown one form of such a "repulsion motor." The rotor is short-circuited along a fixed axis by means of the brushes C C; the stator carries the winding S which produces the field with the axis F. The axis along which the secondary member is short-circuited is displaced by a degrees with respect to F. It is fairly well understood how the magnitude of a affects the general performance of the motor, but we are afraid that the operation of the motor is often attributed to some peculiar repulsive effect between the short-circuited rotor and the stator field such as was discovered by Elihu Thomson in 1887.

Now the term "repulsion motor," although thoroughly justified when applied to Elihu Thomson's original motor, is an entirely unsuitable designation for that type of motor to which it is applied nowadays. This confusion probably arose out of a misapprehension as to the true principles underlying the operations of machines such as are diagrammatically represented in figs. 5 and 7. These machines do not depend for their operation on Thomson's repulsion effect between a short-circuited coil on the rotor and the primary field. In fact, the Thomson effect in these machines is, particularly at starting, directly responsible for a negative torque which can reach extremely high values in a bad design, and which is due to the current in those coils which are short-circuited under the brushes.

We think it is much more correct to consider such motors as being "series induction machines"; it is a more ponderous denomination than the well-established term "repulsion motor," but it is at least correct and will avoid confusion, more particularly as true repulsion motors as originated by Elihu Thomson are, we believe, still made use of. That the motors shown in figs. 5 and 7 are true series induction machines can be easily established.

The running conditions are quite similar to those obtaining in single-phase induction motors, or single-phase shunt induction motors, as the author prefers to designate them. The theory of these motors has been fully set forth by him in an article published recently.*

The machine shown in fig. 1 can be started as a series induction motor by opening one of the rotor short-circuits, say D D, and displacing the whole brush system in such a way that the brushes C C will short-circuit the rotor along an axis forming an angle a with the axis of the stator field as in fig. 2. After a sufficient speed has been attained the brushes D D may be short-circuited, and under these conditions the motor will operate as a shunt induction motor, but that component of the field produced by the stator which falls in the direction D D of the motor field will have a disturbing effect on the operation of the motor, because the phase of that component

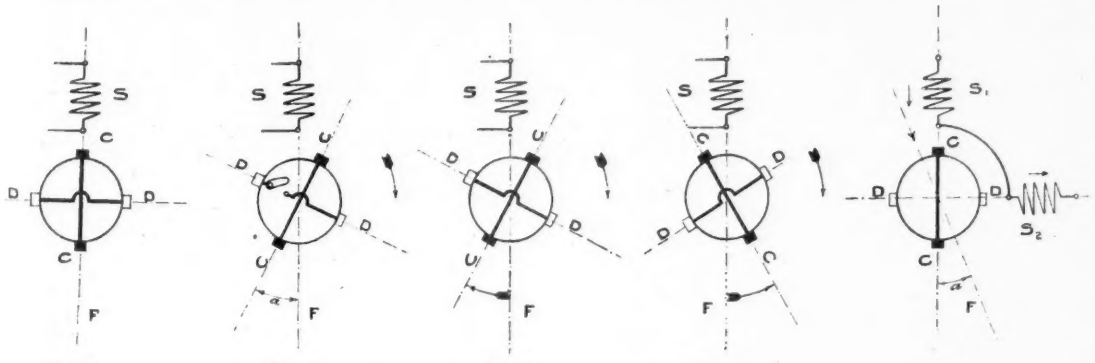


Fig. 1. Fig. 2. Fig 3. Fig. 4. Fig. 5.

will not be the same as the phase of the motor field produced by the current flowing in the D D circuit.

A shunt induction motor, having its rotor short-circuited along two perpendicular axes, operates best when the axis of one of the short-circuits coincides with the stator field axis. If, for instance, a motor of this kind is running in a clockwise direction, and the brush system is displaced *in* the direction of rotation as shown in fig. 3, then the current in the D circuit will fall off while that in the C circuit will rise, the line pressure and the load on the motor remaining constant; on the other hand, if the brush system is displaced in a direction *opposed* to that of rotation, as in fig. 4, then the current in the D circuit will rise while that in the C circuit will fall.

Either condition is detrimental to the working of the motor, and of the two the former gives the worst results.

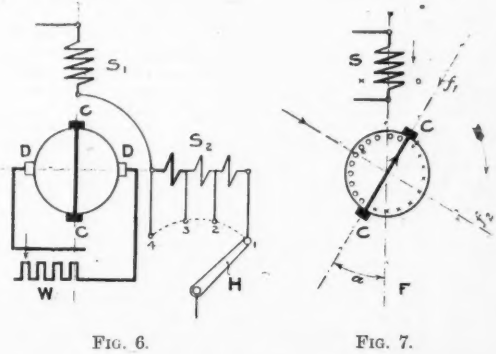


Fig. 6. Fig. 7.

The direction in which such a motor will start depends on the direction in which the short-circuited brushes C C are displaced from their original position of coincidence with the stator field axis; and, with a constant voltage at the terminals, the torque obtained and the current taken depend on the amount of that displacement; but it is obvious that the brush system could not be displaced at all in any commercial machine.

The disposition shown in fig. 5 allows of the direction of rotation being reversed by reversing the current either through S_1 or S_2, but there is no provision for regulating the starting current or the torque, and when the motor has been brought up to speed it shows the same disadvantages as have already been pointed out in con-

* Electrical Review, February 9th and 16th, and March 2nd, 9th and 16th, 1906.

nection with fig. 3. The author, by suitably modifying the disposition shown in fig. 5, gets over all these difficulties simply and effectively. The improved arrangement is shown in fig. 6; it makes it possible to reduce the current taken by the motor, when switched on to the mains, to any desired amount, and it allows of this motor being gradually started and brought up to its normal speed without the use of the usual resistances, transformers, or the like; all that is necessary is a switch such as is shown at H connected to the various tappings provided in the group S_2. With the help of this same switch, the group S_2 can be finally switched out altogether, thus enabling the motor, after it has been converted into a shunt induction machine, to work under the most advantageous conditions, current being supplied to the group S_1 only.

A comparatively small number of turns in the S_2 group will be sufficient in most cases, since an increase in the number of these turns not only reduces the E.M.F. impressed on the armature, and consequently the short-circuit current, but also increases the

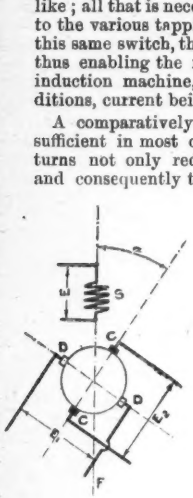


FIG. 8.

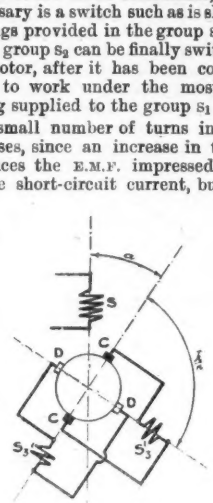


FIG. 9.

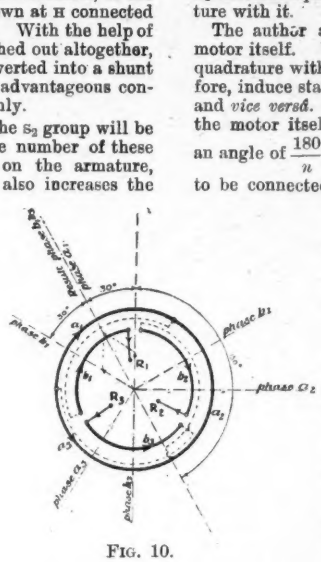


FIG. 10.

total number of turns in series across the mains, and consequently the total impedance of the motor; this rises the quicker because the turns of that group are increased which possesses the greater self-induction. With the same number of turns in both groups, a motor of this type will start light with somewhat less than its no-load current.

The group S_1 provides the transformer field, whereas the motor field is excited by the group S_2, the motor starts as a series induction motor and the greatest torque is secured with the (D or) field brushes on open circuit; were they short-circuited from the very first, this short-circuit in the motor axis would necessarily alter the phase of the motor field and bring it into nearer coincidence with the transformer field, thus increasing the phase discrepancy between the armature current (axis C C) and the motor field, and greatly reducing the torque. As the speed increases, this D circuit can be closed over resistances and these can be gradually cut out, the motor acquiring by degrees the characteristics of what is known as the asynchronous induction motor. If care is taken to close the D circuit at about synchronous speed, the resistances can be dispensed with, and they are not provided with the small motors. Although the motor is now running at practically normal speed, it will only be able to give little power if part of the group S_2 is still in circuit, owing to the weakening effect of this S_2 winding under these circumstances, and also because the densities in the motor will be below the normal.

In order to gradually bring about the more advantageous conditions of fig. 1, and to raise the densities to their normal value, the lever H is gradually moved further and further until the whole of the S_2 winding is cut out. A certain amount of speed regulation, however, can be secured by including more or less of the S_2 winding in the motor circuit and still leaving the D brushes short-circuited.

The conductors of the S_2 group, when the latter is used only for starting, can have a comparatively small cross section. But when this winding is also to be used for speed regulation, the conductors will require to be larger. The stator winding can also be arranged in three divisions on the lines of the ordinary three-phase winding, if this is a manufacturing convenience.

A new, simple and effective method of starting and regulating such motors has now been described, but the motor still has a bad power-factor and a small output for a given weight, and is still liable to spark.

Although the power factor can always be brought up to unity, and although the stator current can even be made to lead its E.M.F., it is not in all cases possible to achieve these results without impairing the efficiency of the machine. It is nevertheless always possible to obtain extremely high power factors without lowering the efficiency.

The method by which the author varies the phase of the motor field in these motors consists in introducing into the circuit D D an auxiliary E.M.F. differing in phase from the E.M.F. (E B) in that circuit due to rotation in the primary field. The resultant of the two is then responsible for the motor field, and the author has found that an auxiliary E.M.F. differing by about 90° from E B, or materially in phase with the motor field, gives the best results. Under these conditions the greatest phase displacement of the resultant E.M.F. can be obtained with the smallest auxiliary E.M.F., and without materially influencing the motor field strength.

Of course this auxiliary E.M.F. can be obtained from any convenient source, provided the periodicity is the same as that of the E.M.F. impressed on the stator and its phase a suitable one. The proper phase of the auxiliary E.M.F. to be applied to the D or C circuit bears a simple relation to the phase of the E.M.F. (E) impressed on the stator. In the general case indicated in fig. 8, let the brush system be so placed that one of the brush sets, C C for instance, forms an angle a with the stator field axis F; then the phase of the auxiliary E.M.F. (E_1) to be included in the D circuit, must differ by a degrees from the phase of E, and the phase of E_2 must differ from it by $90 + a$ degrees. For $a = 0$ the phase of E_1 becomes equal to the phase of E, and the phase of E_2 is in quadrature with it.

The author arranges to procure the auxiliary E.M.F. from the motor itself. We have seen that the motor field is practically in quadrature with the transformer field. The motor field will, therefore, induce statically an E.M.F. in phase with the transformer field, and *vice versâ*. If the auxiliary E.M.F. is then to be obtained from the motor itself, it can be got from the winding whose axis forms an angle of $\frac{180}{n}$ degrees with the axis of the brushes to which it is to be connected; it will then be acted upon by a field of the required phase.

Fig. 9 indicates the position of these windings for the general case illustrated in fig. 8, and, as will be seen from the performance curves of actual motors, annexed to this paper, this method of obtaining the compensating E.M.F. gives excellent results in practice.

The question of sparking is of first importance, and the difficulties met with in this respect gave some trouble and led to delay.

To get over the difficulty completely, the author makes use of a continuous current and polyphase winding in his rotors, combined in such a way that, as far as the commutator is concerned, only the continuous current winding is operative; whilst both continuous and polyphase windings are operative as far as the slip-rings are concerned. The best possible use is thus made of the rotor winding space and copper. The commutator voltage depends on the continuous current winding only. The polyphase winding is so disposed with regard to the continuous current winding, as to obtain at the slip-rings the highest possible voltage resulting from the combination of the two windings.

For the case of a three-phase winding (and this will mostly be used), the relative positions and the mode of connection of the two windings are shown in fig. 10. Since any continuous current winding can be considered as a mesh-connected three-phase winding, this arrangement can be looked upon as the combination of a three-phase mesh and star winding. The three legs of the mesh are designated by a_1, a_2, a_3, whereas b_1, b_2, b_3 stand for the three star legs, and B_1, B_2, B_3 for the three slip-rings. The dotted lines show how the two must be inter-connected, the arrows indicate the momentary direction of the induced E.M.F.'s, assuming a clockwise direction of rotation and a direction of the magnetic field from top to bottom of the sheet of paper. If a is the voltage per phase of the mesh, and b that of the star winding, then the maximum obtainable voltage between any two slip-rings will be $= a + b\sqrt{3}$. This winding makes it impossible for the brush sets disposed on the commutator to be at any time short-circuited, or even nearly so, over the slip-rings; a great number of turns will always be interposed. Tests

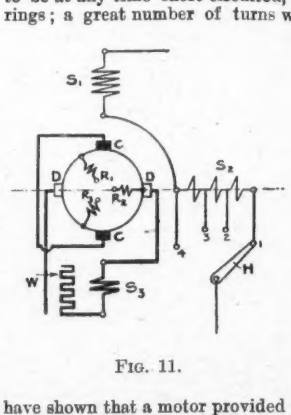


FIG. 11.

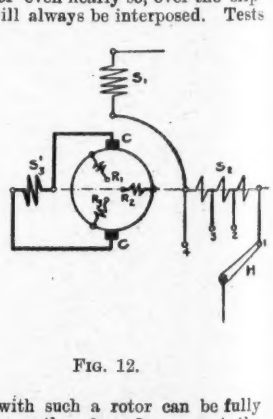


FIG. 12.

have shown that a motor provided with such a rotor can be fully compensated without raising by more than 2 or 3 per cent. the current taking its way over the slip-rings.

The complete motor is shown diagrammatically in figs. 11 and 12 in its two early forms, as arranged for "constant speed work." For the sake of clearness, the slip-rings have been omitted from the figures; they are connected to the points B_1, B_2, B_3 of the rotor winding.

The arrangement shown in fig. 11 allows of the conversion of the motor from a series induction to a shunt induction machine by the gradual closing of the D circuit in combination with a gradual reduction of the number of turns in the group S_2, and, when desired, also in combination with a gradual decrease of the resistances inserted between the slip-rings. A reduction of the resistances inserted in the D circuit, and a reduction of the resistances between the slip-rings increases the shunt excitation; a reduction of the number of turns in the group S_2 after the motor has started reduces the series excitation. At first both methods were used simultaneously on account of sparking difficulties, and one was naturally led to simplify this disposition by leaving out the D circuit altogether. The motor shown in fig. 12 was thus evolved, and quite a number of such machines were executed.

The author thinks that although this last form of motor is simpler than that shown in fig. 11, electrically it is somewhat inferior.

The conversion from series induction to shunt induction working cannot be effected as smoothly with the help of the slip-rings only (fig. 12) as it can with the help of the D circuit (fig. 11); and in the former case it is quite impossible in practice to avoid a very marked falling off in the starting torque curve, which makes this form of motor unsuitable when heavy and sustained starting torques are required. For light work, however, it is very useful, and its power factor under normal working conditions approaches unity. On the other hand, the starting torque curve of the motor in fig. 11 (with or without the help of slip-rings) is an almost straight line, and the motor in this form can be used in all those cases in which heavy and sustained starting torques are required—for instance, for lift and similar work.

The slip-rings are a very unwelcome complication, at any rate for smaller machines, but a way was found of doing without them by simply suitably dimensioning the rotor winding. The experience gained during the numerous tests which were carried out on such machines at one time or another led to the fuller recognition of the factors influencing the process of commutation, and showed the way to the correct design of such armatures.

(*To be continued.*)

The Science of Illumination.

At a meeting of the Illuminating Engineering Society held at New York, Mr. Victor Rettich read a paper on "The Inverted Incandescent Gas Burner," in the course of which he described the various existing types of "downward" lamps. He said that when the gas was burnt downwards at a low pressure, and all the parts of the lamp were cool, the gas was enabled to give kinetic energy to the surrounding air, but when the heating process had started, convection interfered with the flame unless the pressure was sufficiently strong to overcome the upward tendency of the heated air. Various means of overcoming this difficulty had been tried. Generally speaking, inventors had been imitating the form of the electric lamp, and had not paid enough attention to the nature of the mantle. The inverted lamp was found to act admirably in the hands of experts, but somehow the American user had not taken kindly to it, and the New York fire underwriters opposed it because sundry fires had been occasioned by its use. The defects of the downward incandescent gas lamp were:—Danger of falling particles; carbonisation; flashing back; delicacy of mantle suspension; flickering light at low pressure; discolouration of chandelier arms; difficulty of attaching lamps so that they would be gas-tight in the required position; liability of breaking mantles when removing glassware; too much heat thrown off in proportion to the amount of gas used.

Mr. E. L. Elliott, one of the managers of the Society, read a paper on "The Luminous Arc." He remarked that although the invention of the enclosed arc lamp had not been a theoretical improvement, yet its higher practical efficiency drew attention to the fact that there was such a thing as "quality" in illumination as in everything else. With more accurate methods of measuring illumination, the shortcomings of the enclosed arc lamp were becoming more generally recognised. Research had perfected the carbon with reference to withstanding disintegration, and experimenters were now looking in an entirely opposite direction, and it was found that there was a higher illuminative efficiency from incandescent gases than from the incandescence of amorphous carbon. These facts were recognised as long ago as 1836 in England, but they had recently been rediscovered by Bremer. By introducing salts of calcium into the carbon, the arc itself was rendered luminous, the resistance of the carbons was lowered, and the rods could be used farther apart. This type of lamp had been designated the "flame arc lamp," but it would be more scientifically accurate to call it the "luminous arc." The light from the luminous arc was very good for exterior use, and differed in colour-quality from the old arc light, the blue rays of which were easily absorbed in foggy weather, or in the smoke-laden atmosphere of cities. The carbons, moreover, could be made to produce different colours, and the white luminous arc was as near to sunlight in chemical quality as it was possible to imagine. Mr. Elliott claimed that the luminous arc lamp was five times more efficient than the enclosed electric arc. The price of the carbons was higher, but the cost of carbons per candle-power per hour was the same. The use of the luminous arc had led to considerable modifications in the mechanism of the lamp, and the carbons were now generally arranged side by side as in the old Jablochkoff "candles." Blondel had devised a lamp in which one carbon was arranged above the other. The real virtue of the luminous arc light lay in the composition of the carbons, which the different makers claimed to be trade secrets. In conclusion, Mr. Elliott mentioned a new German lamp in which the luminous arc was enclosed and the carbons burnt in a mercury vapour, a small quantity of mercury being placed about ½ in. from the bottom of the carbons. These lamps were said to have a life ranging from 1,200 to 1,600 hours.

Mr. Waldo S. Kellogg also read a paper, on "Illuminating Engineering from the Architect's Standpoint," and averred that the improved intrinsic brilliancy of modern lamps was leading to a waste of illumination. Manufacturers used to say, "We will give you the same light for half the money," but now they were saying, "We will give you double the light for the same money." The æsthetic value of the light was all-important to the architect, and he often had to call for lamps which involved a greater expense than seemed necessary. There was great need for a standard method of rating illumination. The specification of "mean spherical candle-power" was not reliable, and a rating of the lower hemisphere was desirable.

In the resulting discussion of the three papers taken together, Mr. E. C. Brown said he had used the first inverted gas mantle ever imported into the United States. The mantle lasted eight months. Nevertheless, he still used the older form of lamp.

Dr. Clayton H. Sharp, of the Electrical Testing Laboratory, New York, gave full details of the composition and action of the thoria and ceria mantle, and referred to the researches of Prof. Rubens, of Berlin, and of Dr. E. L. Nichols, of Cornell University, N.Y. He said that the actions of the gas mantle and of the electric luminous arc were scientifically identical. In the former the Bunsen flame produced great heat without light, and the mantle converted the heat into light, the mantle being of about the same temperature as the flame, so that there was but little loss of energy. In the flaming electric arc the continuous supply of heated gas was acted upon by the metallic earths, as in the other case.

Dr. E. L. Nichols, who happened to be present, said that his researches showed that temperature was the important factor. Some bodies were only luminescent (*i.e.*, phosphorescent or fluorescent) at the temperature of liquid air, while others needed the heat of the Bunsen burner. The light from the incandescent mantle was peculiar in that it extended over a much wider range of the visible and invisible spectrum than that of any other artificial illuminant.

Mr. W. D'A. Ryan, of the General Electric Co., West Lynn, Mass., showed diagrams of test curves of the Magnetite, Bremer, Excello, Siemens and Bausch electric flame arc lamps. The first four named gave a better horizontal distribution, and were the more suitable for street illumination. The Bausch lamp gave a good vertical illumination.

THE ROYAL SOCIETY CONVERSAZIONE.

There was a large number of exhibits at the first annual Royal Society Conversazione on May 9th, and a considerable number of these were of interest to the electrician or to the physicist.

The portable wireless telegraph apparatus exhibited by Sir Oliver Lodge and Dr. Alexander Muirhead shows how much scientific knowledge and practical experience has been able to effect in reducing the weight and bulk of this class of apparatus. The leading idea in the design of this apparatus is the utilisation of the electric valve, to enable a much smaller coil to be used to charge the aerial conductors to the discharging potential. The aerial conductors are of a special highly efficient and very light construction. They consist of two horizontal wirework rectangles supported on bamboo poles at a vertical distance apart of about 40 ft. Each rectangle is connected to an opposite pole of the coil (through the electric valve), neither rectangle being connected to earth. The exciting electric current is obtained from a dynamo mounted on a bicycle frame and driven by the crank gear. Lodge's disk-oil-mercury coherer, with a telephone receiver, is used. The apparatus is chiefly intended to be used for military field purposes. It is available for communicating across country for distances up to 50 miles, or to 150 miles over sea. Each of the two boxes containing the apparatus weighs about 65 lb., and the two may be suspended as panniers on the back of a mule.

Mr. W. Duddell exhibited his apparatus intended to demonstrate some mechanical and electrical phenomena occurring in the telephonic transmission of speech. Curves were shown on a screen, representing the simultaneous movement of the microphone transmitter diaphragm, the current flowing into the telephone line, the current received at the far end of the line, and the movement of the receiver diaphragm when sounds or speech are being transmitted. The similarity of, and the difference between, these four curves can be examined by the aid of the apparatus, and the distortion and attenuation produced by the resistance, capacity, and self-induction of the line can be demonstrated, as well as the distortions produced by the diaphragms of the transmitter and the receiver. The characteristic shapes of the train of waves corresponding to each vowel sound were shown on the screen, and their dependence on the pitch at which they were sung.

Interesting photographs of electrical discharges at atmospheric pressure and in vacuo were exhibited by Mr. Kenneth J. Tarrant. The photographs showed the effects obtained from an interrupted continuous current, and from a high frequency oscillating one, also between parallel conductors, both insulated and bare, of varying capacity and with various

condenser conditions. The spiral or vortex nature of the discharge was clearly shown in some of the photographs.

Sir James Dewar exhibited metal jacketed vacuum vessels for the storage or transport of liquid air. The vacuum in the hollow walls of these vessels was maintained by cooled charcoal, which at low temperatures absorbs a very large volume of air. The envelopes may be made of brass, copper, nickel or tinned iron, the necks being made of a bad-conducting alloy. The necks are covered with inverted silvered glass test tubes, which act as stoppers, and at the same time utilise the cold of the slowly evaporating liquid. The efficiency of the best metallic flasks is equal to that of the average silvered glass vacuum vessels now generally used in low temperature investigations.

Lord Blythswood exhibited some very fine arc spectra produced by a Blythswood concave diffraction grating. The radius of the grating was 10 ft., the first order spectrum being photographed, and the total length of the spectrum was 40 in. Salts of the elements were fed into a carbon arc on a 100-volt circuit.

Prof. Wyndam Dunstan exhibited a number of new and rare minerals from Ceylon. Many of these minerals have been collected during the progress of the mineral survey now proceeding in Ceylon in connection with the Imperial Institute. The wide distribution of radio-active minerals, especially thorium and uranium, is of interest.

Dr. P. E. Shaw exhibited his electrical measuring machine. In this machine the principle of electric touch is utilised, instead of mechanical touch, which is used in machines of the Whitworth type. The framework and feeding mechanism of the machine are somewhat similar to that of a Whitworth machine, but contact between the sliding bars of the machine and the gauge or piece being tested is indicated by the closing of a telephone circuit when contact is made. The ends of the sliding bars are rounded, so that contact is made at a point, and errors in the flatness and parallelism of the ends of the gauge can thus be detected. The strain in a machine of this type is negligible. The machine exhibited measured easily to a quarter-millionth of an inch, and with care might be used to detect a difference of a millionth of an inch. The machine is described in the *Proc. Roy. Soc.*, Vol. 77, A. 518.

Mr. E. G. Rivers exhibited an electric heater constructed on a new principle. The object in view is to secure a large heating surface at a moderate temperature, and the method exemplified is the use of silicated carbon upon a terra-cotta base, forming an "element." These "elements" assembled together, constitute the heater. The current taken by one element at 200 volts is ·15 of an ampere, and the heater exhibited, having 12½ sq. ft. of heating surface at 205° F., takes 3·5 to 3·75 amperes. This will warm a room 12 ft. × 12 ft. × 10 ft. high at a cost of about 1 1/2d. per hour, at 1½d. per unit.

There was a considerable number of exhibits by the Director of the National Physical Laboratory. One of these was an apparatus for testing the strength of materials at very high temperatures. The apparatus consists of a small electric furnace of the horizontal type. The specimens to be tested are in the form of rounds disks, 20 mm. in diameter, and 3 mm. thick. The method is available for the study of refractory materials such as are used for the linings of steel furnaces and for water-tube boilers, for the various kinds of firebrick, and, in short, for the study at temperatures between 800° and 2,500° C. of any substance not rapidly attacked by carbon or by a strongly reducing atmosphere. The specimen is supported at about the level of the electrodes on a shelf in a vertical graphite tube, open below. A definite load is applied to the centre of the disk, by a thin vertical graphite rod suitably guided. The temperature at which the sample breaks or begins to yield, can be determined with considerable accuracy by a suitable optical pyrometer focussed on the lower side of the disk itself.

Another exhibit from the National Physical Laboratory was the Picou permeameter. This instrument, the invention of M. R. V. Picou, is designed for testing the magnetic permeability of rods or strips. The test piece is clamped between a pair of yokes, which can be put magnetically either in series or parallel, and by means of independent magnetising coils wound on the yokes, exact compensation is obtained for the reluctance of the yokes and the four joints. When this compensation has been effected, the corresponding value of B is obtained from the throw of a ballistic galvanometer, the magnetising H being applied by a third coil round the test piece.

Prof. S. P. Thompson delivered, during the evening, an interesting lecture with experimental and lantern demonstrations on the electric production of nitrates from the atmosphere. This subject was first brought into prominence by Sir William Crookes's presidential address to the British Association some years ago. He pointed out that the natural supply of manures would soon become exhausted, and that the wheat crop necessary for the maintenance of the ever-increasing population of the earth could not be produced unless some cheap way were discovered of manufacturing nitrates from the nitrogen of the atmosphere.

Prof. Birkeland appears to have made considerable progress towards the desired end. The calcium nitrate process of Birkeland and Eyde has been at work for more than a year at Notodden, in Norway. The special feature of their apparatus is the furnace in which the synthesis of the nitrogen and oxygen of the atmosphere is effected. Electric discharges are produced by alternating currents at 3,000 volts between copper electrodes. These discharges are spread out into a disk formed by placing the spark gap between the poles of a powerful electro-magnet. Through this disk, which may be 6 ft. in diameter, a gentle current of air is passed. The nitrous vapours with which the air is thus charged are passed through absorbing towers, where they are absorbed in water and in quicklime, the whole of the products being converted into calcic nitrate, which is concentrated. This product is used for agriculture (being equal in value to Chili saltpetre), and in the dye-stuff industry. The power is furnished by waterfalls. One kilowatt is capable of producing 500 kilogrammes of nitrate per annum.

PARLIAMENTARY.

L.C.C. Tramways.

(*Concluded from page* 777.)

THURSDAY, MAY 10TH.

ON Thursday last week Sir Lewis McIver's Select Committee of the House of Commons announced its decision on the L.C.C. Tramways Bill, which had occupied the Committee for the whole of the previous week.

The CHAIRMAN said that the Committee found the preamble of the Bill had been proved, with the exception of the tramways in the Edgware Road. That decision also affected the Bill of the Middlesex County Council for tramways in the same thoroughfare (the Bill was taken with that of the L.C.C.), and the preamble of that Bill was accordingly found not proved. With regard to the Embankment Tramways and the trams over the bridges part of the scheme, the Committee amended the scheme in several particulars. It was decided that a width of 2 ft. of pavement must be thrown into the roadway of Westminster Bridge on either side of the bridge, the tramway lines to occupy the centre of the bridge, and not the down-river side as the Bill proposed. Certain powers were also given to the police in regard to the stopping of the trams on certain occasions. As to the Embankment portion of the project, pending the widening of Blackfriars Bridge, the Council's tramways were to have a terminus at the corner of John Carpenter Street. The Committee further imposed the condition that the lines were to be constructed within five years, instead of the seven years provided by the Bill, the period to coincide with the five years allowed to the Corporation for the widening of Blackfriars Bridge.

The Bill was then ordered for third reading.

North-East London Railway Bill.

THIS measure came before the Unopposed Bills Committee of the House of Commons on Friday last week.

Sir DOUGLAS FOX, the engineer to the promoters, said that the Bill proposed to authorise the taking of two additional pieces of land, and to raise additional capital to the extent of £250,000 for rolling-stock, &c.

Sir CHANDOS LEIGH: Have you raised any capital yet?

Sir DOUGLAS FOX: Very little. I can tell you what we have done. We have set out the whole of the line, and the whole of the working drawings have been prepared.

The CHAIRMAN: What was the original capital?

Sir DOUGLAS FOX: £3,000,000. Witness said that it was proposed to pay interest on the new capital. The line, he said, in reply to the Chairman, was about 15 miles long; 4 miles of it was

in tube, and the cost per mile was about £450,000 for the tube part, and £80,000 for the open line.

Lord ROBERT CECIL: About £200,000 per mile on the average?

Sir DOUGLAS FOX: I think it is £260,000. It is a very moderate cost.

The Committee allowed the Bill to proceed.

Metropolitan District Railway Bill.

THE Select Committee of the House of Commons, presided over by Sir Geo. Doughty, on Tuesday, May 8th, considered the Bill promoted by the Metropolitan District Railway Co.

Mr. FREEMAN, K.C., who, with Mr. Clode, appeared for the promoters, said it was an omnibus Bill dealing with a number of different matters. The principal objects of the Bill were for making a number of small railways, which were mostly widenings of bridges on which the railway went. There was no opposition to that. There were also certain provisions relating to capital to which there was no opposition, and several miscellaneous matters. The only two points which he would deal with were matters on which there was opposition from the Corporation of the Albert Hall and the London County Council. There was a proposal in the Bill to construct a subway from South Kensington Station to the Albert Hall, which was a proposal that had been several times before Parliament. Two or three portions of the subway were already in existence, and it was proposed to unite them up and make a complete subway.

Mr. MACONOCHIE, interposing on behalf of the Corporation of the Albert Hall, said that his clients were prepared to accept the protective clause offered by the company.

Mr. FREEMAN said that, with regard to the opposition of the London County Council, it was over the taking in of land at Lillie Road, Fulham Road, and Back Church Lane, Hammersmith. The company felt that the Council ought to pay for the land in Fulham Road, while the company would hand over the land in the other two places.

Sir GEO. GIBB (chairman of the company) was examined, and said the company were quite willing to give the land in Fulham Road for a street improvement if the Committee considered that they ought.

Mr. TALBOT (for the L.C.C.) said that the proposal of the County Council was to have the equivalent of the land taken at Lillie Road and Back Church Lane given by the company, while they were willing to pay for the land in Fulham Road.

The CHAIRMAN said it seemed that the giving of the land in the Fulham Road would be assisting a great public improvement.

Mr. TALBOT said the proposal of the County Council dealt with a matter of principle.

The COMMITTEE eventually decided to pass the preamble of the Bill, and ordered that the County Council should pay for two of the sites, and that the Fulham Road site should be given to the public by the company.

North-West London Railway Bill.

THIS Bill came before Mr. Compton Rickett's Select Committee of the House of Commons last week.

Mr. BALFOUR BROWNE, K.C., for the promoters, explained that it was an extension of time Bill, and also sought to authorise a proposed extension from the Marble Arch to Victoria. One reason why the railway had not yet been constructed was that it had been hoped that a physical connection might be formed with the Central London Railway. Another reason was that the proposed extension was not included in the former Bill, and the whole project had been hung up pending the publication of the Traffic Commission Report. After protracted negotiations with the Central London line it had been found that a physical connection was impossible. With regard to the Traffic Commission Report, that had stated that the opinion of the Commissioners was in favour of such a line as that proposed, including the extension to Victoria. The Commissioners of Woods and Forests had agreed to the railway passing under Hyde Park, and had given the promoters a piece of land in the Park near St. George's Hospital, where an exchange station with the Brompton, Piccadilly and Great Northern Railway would be made. At Victoria there would be inter-communication with the L.B. and S.C. Railway and L.C. and D. Railway Co.'s lines. The promoters of the extension were the promoters of the original line—the Brush Electrical Engineering Co. With a tube 11 ft. 8¼ in. in diameter, the line as it stood was estimated to cost £1,580,821, while the electrical equipment would cost £450,000.

Mr. W. L. MADGEN, a director of the Brush Electrical Engineering Co., was called, and stated that the railway from Cricklewood to Victoria was just under six miles in length, and the distance would be covered in 17 minutes. The fares had not yet been decided. If the Bill were passed his company would invest £100,000 in the scheme, and there would be no difficulty in raising the rest of the £3,000,000 capital. He thought that his company having persevered with the scheme had a right to the contract, but there was no agreement as to that.

WITNESS, under cross-examination by Mr. Freeman, K.C., who appeared for the Duke of Northumberland and other petitioners against the Bill, said that the line would have to carry 36 millions of passengers at 2d. to pay 5 per cent. on the capital all round. Replying to further questions, Witness said that the power for the compulsory taking of lands by the company came to an end last year, but by this Bill it was proposed to revive and extend those powers.

On Thursday, May 10th, the CHAIRMAN said that the Committee had given particular attention to the question of finance. If they passed the preamble they would impose a time limit within which the railway was to be commenced and the capital substantially raised. The Committee further desired that the £100,000 which the Brush Co. had undertaken to subscribe should be in some way or other a matter of contract, and if that company secured the order for the plant it should be on fair and equitable terms to be decided by an independent referee or arbitrator.

A number of witnesses having been called in support of the scheme, the Committee adjourned.

Edinburgh Corporation Tramways.

A SELECT COMMITTEE of the House of Commons, presided over by Mr. J. W. Wilson, last week considered the Bill promoted by the Edinburgh Corporation which, amongst other things, seeks to authorise the Corporation to construct additional tramways, and to convert existing tramways for electrical working. Mr. Pembroke Stephens, K.C., and Mr. Maconochie represented the Corporation, and Mr. Balfour Browne, K.C., and Mr. Hutchinson appeared for the Edinburgh and District Tramways Co., who opposed the tramway portion of the Bill.

Mr. STEPHENS, in opening, stated that the Corporation were the owners of all the tramways in the city, with the exception of two small portions which were subject to the rules of purchase. There was one old horse tramway and all the others were cable. The Corporation were proposing by the Bill to cable or electrify the extensions they wished to make, and it was considered most desirable. The tramways were worked now by the company under an agreement with the Corporation. By this agreement the Corporation were empowered to construct such new tramways as they might deem expedient. Apparently for the first time since the agreement was made, the company were objecting to all the tramway proposals in the Bill.

Mr. BALFOUR BROWNE said the matter of the Gilmore Place horse tramway was a question of argument on the agreement; but the Broughton tramways were a matter of evidence. He admitted that the Corporation had the right to propose to work the tramway by electricity, but it was for the Committee to say whether it would be a convenient thing to use electricity for this tramway, seeing that it connected with a cable system. That the Gilmore Place tramway was a horse tramway was absolutely due to the default of the Corporation. The contention of the company was that if this tramway was converted it must be to cable and not electricity.

Mr. PEMBROKE STEPHENS intimated that it was the intention of the Corporation to work the new tramways, and the reconstructed horse tramway, by electricity.

Mr. BALFOUR BROWNE said that if the Committee allowed electricity, the company must work the extension; and he asked if it was not for the convenience of the public to have one system throughout, which should be cable.

Mr. P. STEPHENS pointed out that by the lease it was open to the Corporation to have cable or electricity, and they must not be shut out from getting the best system.

After further argument, the COMMITTEE decided that the Gilmore Place tramway should be cabled, as they pointed out that it would be absurd to electrify a quarter of a mile of tramway at the end of a long tramway not electrified. Had the Corporation's intention been to convert the four miles of tramway for electric traction the question would have been very different.

The question of the Broughton Street new tramway and the Canonmills extension was then gone into, and evidence was called in support of the schemes. The Committee decided to allow the construction of the tramways, and to confine themselves to the question of what the system should be.

Sir ROBERT CRANSTON (Lord Provost) gave evidence to the effect that the new line would join the Leith tramways, with respect to which the Corporation had the right to purchase one half. He considered that the electrification of this line would be a great advantage. There would almost immediately be developments in electric traction at Joppa and from Dalkeith to Liberton. They were not making arrangements simply for the present but also for future development of the tramway system.

Mr. BALFOUR BROWNE said the company's contention was that they would be under the obligation of working tramways which would not be remunerative, and they would be bound to get cars which would be on their hands at the end of the lease.

The Committee having consulted, the CHAIRMAN said they felt that when a great Corporation like Edinburgh came and said the tramways were necessary, the Committee were almost bound to accept it. The Committee and Parliament were not responsible for the agreement or the arrangement between the Corporation and the company, and he presumed that the advantages and disadvantages had been weighed by the parties entering into the arrangement, and there was no doubt a certain amount of risk. If the lines were electrified, the cost of the working would not be more and the cost of rolling stock would not be more, although a few more cars might have to be bought. Consequently, they had decided to allow the proposals of the Corporation.

London Outer Circle Railway.

A SELECT COMMITTEE of the House of Commons, presided over by Sir George Doughty, commenced on Tuesday the consideration of this Bill. Mr. C. A. Cripps, K.C., Mr. Fitzgerald, K.C., Mr.

Hutchinson and Mr. Lyndon Macassey appeared for the promoters. There were altogether 26 petitioners against the Bill, including all the railway companies with whose lines it was proposed to form junctions; a number of local authorities; and a number of private persons.

Mr. C. A. Cripps, K.C., said that the proposed railway would be 32½ miles in length, and would serve a rapidly developing suburban district. Altogether a capital of £6,000,000 would be required, but evidence of well-known financiers would be called to show that no difficulty was anticipated as to the raising of the capital. Power was taken in the Bill to work the railway by electricity under what was known as the single-phase system, and a sum of £500,000 was put down in the estimates for an electric generating station. It was, however, thought that possibly that sum would not be required, because electricity might be obtained from some of the large sources of supply being proposed at the present time. The estimated cost of actual construction, including land, was £3,320,000, but that did not include the equipment. Dealing with the line proposed, Mr. Cripps stated that it would commence at Feltham with a junction with the London and South-Western Railway, and would end at West Ham with a junction with the London and Tilbury Railway. It was proposed to join up the following lines at the following places:—The Great Western Railway at Southall; the new line of the Great Western and the Great Central Railways at Northolt; the Metropolitan District Railway near Wembley; the Great Central Railway near Wembley; the London and North-Western Railway near Wembley; the Metropolitan and the Great Central Joint Railway line between Wembley and Kingsbury; the Midland Railway near Hendon; the Great Northern Railway near Finchley; and the Great Eastern Railway at Tottenham and Ilford. The chief opponent of the new line was the Great Eastern Railway, who had the bulk of the traffic at present from the North to the South. A railway such as that suggested was recommended by a Parliamentary Committee as far back as 1863. In 1882 a Bill for such a railway was sanctioned, but the scheme fell through, and later a Bill for a railway of somewhat similar character was sanctioned, and this also fell through. The promoters of the scheme included Lord Fortescue, Sir S. Montague, the National Electric Construction Co., and others.

Metropolitan Railway Bill.—This Bill, which provides for the enlargement and improvement of Baker Street station and the acquisition of additional lands at Ickenham for a goods yard, should have come before Sir G. Doughty's Select Committee of the House of Commons on Tuesday, May 8th, but no opponents appeared, and the Bill was referred to the Unopposed Bill Committee.

Ascot District Gas (Electric Lighting) Bill.—This Bill came as an unopposed measure before the Chairman of Ways and Means on Thursday, May 10th, and was ordered to go for third reading. It gives the existing gas company power to supply electricity.

London County Council (Electric Supply) Bill.

(*Continued from page* 779.)

Wednesday, May 9th.

Mr. Rider was again in the witness chair, and replying to members of the Committee, he said that it was true that coal could be purchased at the pit's mouth, say at Nottingham, at 4s. less than the 19s. 6d. in his estimates; but he did not think that the saving would cover the cost of transmission.

Mr. Rutherford asked the witness whether the Greenwich generation station was not, as a matter of fact, out of date, and did he not know that all plant erected during the past 25 years had become obsolete within the last 5 years? Mr. Rider answered these questions by saying the Greenwich station was thoroughly up to date and efficient. Of course, plant did become obsolete in time, but he had no idea of scrapping the plant at Greenwich, and starting afresh.

Questioned in regard to Clause 35, Witness said that in his opinion it ought to apply to all authorised distributors whether taking a supply from the Council or not.

Mr. Robert Hammond, M.I.E.E., &c., consulting electrical engineer to the L.C.C., was then called, and submitted a large number of tables dealing with the subject of electricity supply in London. From one of these tables, which showed the capital expenditure by authorised distributors, it appeared that the capital expenditure on electricity undertakings by local authorities was as follows:—Within the County of London, £4,877,303; outside the county, but within the area covered by the Bill, £1,725,143; thus giving a total of £6,602,446. In the case of companies, the figures were:—Within the County of London, £11,613,809; outside, but within the area covered by the Bill, £246,259; a total for the companies of £11,860,068. Adding the two totals, it would be seen that the total amount of capital expenditure by authorised distributors, both inside and "outside" the county was £18,462,514. The same table showed the maximum load in kilowatts, the plant capacity in kilowatts, the capital expenditure on generating plant per kilowatt of plant capacity, and the total capital expenditure per kilowatt of plant capacity. Dealing with these matters separately, Witness explained that in the case of local authorities the maximum load in kilowatts was:—Within the county, 20,881 kw.; outside the county, but within the area covered by the Bill, 10,931 kw. In the case of the companies the figures were:—For companies within the county, 80,195; without, but within the area of the Bill, 1,033. The plant capacity of the local authorities within the county was 35,714 kw.; without the county, but within the area covered by the Bill, 22,340 kw.; while the plant capacity of the companies within the county was 120,026 kw.; and without the county, but within the area covered by the Bill, 2,432. These figures gave a total plant capacity of 58,054 kw. for the local authorities, and 122,458 kw. for the companies, or a combined total of 180,512 kw. Coming to the other sections of the table, Mr. Hammond said that the capital expenditure on generating plant per kilowatt of plant capacity averaged £44·94 for local authorities within the county, and £36·74 for local authorities outside, but within the area covered by the Bill, the average of the two being £41·79 per kilowatt on the plant. In the case of the companies the figures were:—Companies within the county, £51·67; without the county, but within the area in the Bill, £41·74; the average of the two in this case being £51·47. It would be seen, therefore, that the average capital expenditure on generating plant per kilowatt of plant capacity for both companies and local authorities, within and without the County of London worked out at £48·35. As to the total capital expenditure per kilowatt of plant capacity, that was £87·63 for local authorities, within the county, and £72·43 for local authorities without the county, giving an average of £81·74. In the case of the companies the figures were:—£96·76 for companies within the county, and £91·12 for companies without the county, giving an average of £96·65. For the whole the average cost, therefore, was £91·85, for companies and local authorities together.

Thursday, May 10th.

Mr. Hammond, continuing his evidence, put in several other tables, among them one dealing with the gross profits made by the various local authorities distributing energy. In tabulated form, the figures for 1905 were:—

Authority.	Capital expenditure.	Sinking fund.	Surplus.	Gross profit.
Battersea	£216,723	£4,268	£295	£10,984
Bermondsey ...	106,669	363	1,113	4,652
Fulham	204,324	3,161	29	9,477
Hackney	273,897	5,825	5,537	20,224
Hammersmith ...	210,994	5,603	5,283	18,815
Hampstead ...	367,951	15,111	9,182	34,657
Islington	410,229	6,356	4,547	22,818
St. Pancras	484,108	7,259	13,099	35,273
Shoreditch	315,396	4,304	2,686	17,111
Southwark	82,807	2,197	382	4,892
Stepney	216,267	2,276	5,845	14,850
Stoke Newington ...	2,258	71	292	447
Poplar	238,061	3,045	*	8,548
Woolwich	221,084	3,074	†	1,394

* Deficit on the year's working of £1,271. † Deficit on year's working of £8,137.

Witness put in similar figures for the authorities outside the County, but included in the area covered by the Bill, and also tables showing the dividends paid by the various companies' undertakings. Coming to a consideration of the possible future demands for electricity, he said that he estimated the requirements of London in the year 1911 at 273,863 kw., this representing an output in Board of Trade units of 554,038,552. He considered that if the L.C.C. had been able to have given a supply in 1905, a saving might have been effected to the extent of £533,177, this conclusion being arrived at by comparing the cost of generation by the authorised distributors with the cost at which the supply could have been given by the Council. A saving of £44,716 might in a similar manner have been made in the area outside the County.

Financial Results of Authorised Distributors.

(a) Local Authorities.

Undertaking.	Capital expenditure.	Gross profit.	Interest and special expenditure.	Sinking fund.	Financial result. Surplus + deficit −
1. Within the County of London	£ 3,350,767	£ 204,142	£ 102,347	£ 62,913	£ 38,882 +
2. Outside the County of London, but within the area covered by the Bill	1,709,209	107,476	50,943	45,704	10,829 +
Totals .. £	5,059,976	£311,618	£153,290	£108,617	£49,711 +
Per cent. to aggregate capital ..		6·16 %	3·03 %	2·15 %	·98 %

(b) Companies.

Undertaking.	Capital expenditure.	Gross profit.	Interest and special expenditure.	Depreciation.	Balance available for distribution.
1. Within the County of London	£ 11,613,809	£ 928,091	£ 206,778	£ 201,976	£ 519,337
2. Outside the County of London but within the area covered by the Bill	246,259	15,535	5,141	2,850	7,544
Totals	£11,860,068	£943,626	£211,919	£204,826	£526,881
Per cent. to aggregate capital ..		7·96 %	1·79 %	1·73 %	4·44 %

The following table shows the growth of demand for electrical energy in the proposed area of supply, and gives the maximum demand in kilowatts:—

Year.	Undertakings belonging to		Total.
	Local authorities on March 31st.	Companies on December 31st previous year.	
	KW.	KW.	KW.
1900	7,468	38,305	45,773
1901	11,038	45,602	56,640
1902	14,732	54,004	68,736
1903	22,091	62,407	84,498
1904	28,256	71,616	99,872
1905	33,295	81,678	114,973
Increase of 1905 over 1900	25,827	43,373	69,200
Percentage of increase ...	346 %	113 %	151 %

TUESDAY, MAY 15TH.

Mr. HAMMOND was re-examined by Mr. CLEESE. Witness said that in his opinion the power to raise money at a cheap rate was a distinct advantage when large sums were dealt with. It was a fact that there were large parts of the area where no bulk supply was given; the companies had not developed that supply to any extent. Where they did give such a supply the price charged was such as would not tempt the ordinary consumer. At Stoke Newington the price charged was 7d. for the first hour, and 2d. after for lighting, and 5d. for the first hour, and 1d. after for power. He considered that the 60,000 KW. provided by the Bill was ample for the present requirements. If the scheme was a success they would have to come for further powers. So far as efficiency went, the capital spent on the large sets of plant proposed by the Council would be spent more advantageously, and, in spite of the 5 per cent. loss, would enable the distributors to obtain a supply at a cheaper rate. Witness then submitted the tables (which had been asked for last week), showing the respective estimated costs of the Greenwich station supply and the supply from a station at St. Neots for a bulk supply of 85,500 KW. in and around London, as follows:—

A.—ESTIMATED CAPITAL EXPENDITURE.

	London County Council's scheme for generating at Greenwich and Battersea.	Scheme for generating near St. Neots.
1. Land for generating station	£90,000	£11,250
2. Buildings	721,740	412,000
3. River work	116,181	10,000
4. Machinery and plant	1,169,947	1,068,000
5. Overhead transmission to Enfield	—	555,600
6. Step-up and step-down transformers, switchgear and cables..	—	180,000
7. Land and buildings at Enfield	—	50,000
8. Transmission system to supply centres, &c.	1,065,187	2,355,280
9. Interest on capital outlay during construction	105,000	202,000
	£3,268,055	£4,844,130

1. LANDS.—The cost would be considerably less than for London Works.
2. BUILDINGS.—The cost is lower than the total cost of the Greenwich and Battersea Works, not only on account of smaller dimensions owing to concentration of plant, but also owing to reduced cost of labour and owing to use of low steel chimneys instead of brick ones.
3. RIVER WORK.—Much reduced, no pier being necessary.
4. MACHINERY AND PLANT.—Owing to the losses in transformation and transmission to Enfield the capacity of plant would have to be increased from 85,500 to 100,000 KW. The total plant installed would be 120,000 KW. in order to provide for standby. The County Council scheme, including Greenwich and Battersea, provides for 114,000 KW. installed, but the cost is greater owing to sub-division into two stations and to the smaller units of plant.
5. OVERHEAD TRANSMISSION SYSTEM.—Total length, 50 miles to Enfield. The estimate is based upon the assumption that the wires would be carried on steel lattice towers at least 45 ft. high, and the working pressure would be 30,000 volts. The transmission lines would occupy a strip of land about 300 ft. wide for the whole distance.
6. STEP-UP AND STEP-DOWN TRANSFORMERS with the necessary switchgear and connecting cables would be required at both ends of the transmission line.
7. LAND AND BUILDINGS would be required at Enfield for the step-down station.
8. UNDERGROUND TRANSMISSION SYSTEM.—Cables of the same total capacity as are included under the London County Council scheme are provided from Enfield to the same 29 supply centres, but they are based on a working pressure of 11,000 volts. The higher pressure is necessary owing to the average length of these cables being nearly twice the length of the cables required from Greenwich and Battersea.

B.—ESTIMATED WORKING EXPENSES.

85,500 KW. maximum load at one time with a load factor of 35 per cent.
Output (from Greenwich and Battersea, or from Enfield) = 262,143,000 units per annum.

	London County Council's scheme for generating at Greenwich and Battersea.		Scheme for generating near St. Neots.	
1. Generation—				
(a) Coal	£175,051		£121,778	
(b) Water, oils, &c.	11,300		12,200	
(c) Labour..	21,640		18,600	
(d) Repairs and maintenance ..	24,190		26,150	
		£232,141		£178,728
2. Transmission—				
(a) Repairs and maintenance on overhead transmission lines	—		£36,780	
(b) Repairs and maintenance on underground transmission lines	16,500		33,000	
(c) Easements.	—		12,500	
				£82,280
3. Capital charges—				
Generating stations	£118,459			
Transmission system	84,388			
	202,847		300,700	
4. Management and office	10,300		10,300	
5. Rent, rates and taxes	42,760		37,000	
	£504,548		£609,008	
	or 0·4618d. per unit.		or 0·558d. per unit.	

1. GENERATION.—In connection with these costs it should be noted that in order to deliver 262,143,000 units at Enfield to the underground transmission system as in the case of Greenwich and Battersea combined, it is necessary to generate 283,400,000 units at St. Neots to cover the loss in the overhead transmission and in transformation.
(a) Coal.—Taken at 3·5 lb. per unit and 5s. 6d. per ton. The total consumption would be 442,810 tons per annum.
(b) Water, Oil, &c.—The same cost per unit is taken in each case.
(c) Labour.—Owing to the lower rate of wages obtaining at St. Neots a saving is effected in this item in spite of the extra number of units generated.
(d) Repairs and Maintenance.—The same cost per unit is taken in each case.
2. TRANSMISSION.—(a) Overhead Transmission System.—This item is taken at 5 per cent. on the total cost. The cost of patrolling the line and of maintaining the lattice towers and the insulators is necessarily heavy.
(b) Underground Transmission System.—The same percentage cost is taken in each case.
(c) Easements.—This item is based upon a payment of £250 per mile per annum.
3. CAPITAL CHARGES.—The same percentage cost on the total capital expenditure is taken in each case.
4. MANAGEMENT AND OFFICE EXPENSES.—The same figure is included in each case.
5. RENT, RATES AND TAXES.—The St. Neots scheme would effect a saving on this item in respect of the generating works, but the rating of the overhead transmission system and also the increased rating cost of the more extensive underground transmission system to some extent counterbalance this. On the whole it is assumed that a net saving of £5,760 would result.

Replying to a member of the Committee, Mr. HAMMOND said that he did not think it would be better for the Council to distribute as well as generate. Distribution must take place from various places, whereas in the case of generation, it was admitted that there was an advantage in centralisation. The 300 ft. width for the transmission lines was based upon the Board of Trade regulation that not more than 2,000 KW. could be carried on one cable, and that the cables must be 6 ft. apart.

Mr. RUTHERFORD (a member of the Committee): But do you know that the Board of Trade regulation is absurd?—WITNESS: I never say that about the Board of Trade, but I think in this case it might, perhaps, be increased to 8,000 KW.

(To be continued.)

London United Tramway Bill.—This Bill came before a Select Committee of the House of Commons, presided over by Sir Geo. Doughty, on Tuesday, May 8th. Mr. Fitzgerald, K.C., who represented the promoters, said it was an omnibus Bill promoted by the London United Tramway Co. to enable them to acquire land in various parts of their district for street works and improvements, and to give them an extension of time for the construction of a certain number of tramways. So successful had the company been in supplying the wants of the public that on their 50 miles of tramway they carried last year 50 millions of passengers, and so liberal had they been in meeting the demands of the local authorities that they had actually spent on street widenings and improvements about £900,000, without taking into account the money spent on the construction and equipment of tramways. In the case of the Bill before the Committee there were originally 19 petitioners, but the promoters had been so anxious to meet their opponents in every way that they had settled with 18 of them. The only objecter now was Mr. Smallman, who had acquired what was known as Merton Abbey for a building estate. By an agreement with the Croydon Rural District Council, the promoters had agreed to widen the Merton High Street, and wished to take a strip of land belonging to Mr. Smallman. After hearing evidence, the Committee found the preamble of the Bill proved.

Folkestone and District Electric Supply Bill.—The Lord Chairman of Committees has reported that all opposition to this Bill has been withdrawn.

Electric Lighting Provisional Order Bills.—The first two electric lighting Confirmation Bills came on Thursday, May 10th before the Unopposed Bill Committee of the House of Commons, and were ordered to be reported for third reading. The orders apply to Waterford, Abercarn, Berry, Bettwsycoed, Blaydon, Calverley, Farsley, Foots Cray, Horsforth, Market Harborough and Wembley.

Telegraph Guarantees.—In the Parliamentary Papers Mr. Lloyd Morgan asks the Chancellor of the Exchequer whether the proposed alteration in telegraph guarantees in rural districts, whereby the Postmaster-General takes two-thirds of the risk, will apply to existing guarantees or only to those entered into after the passing of the Finance Bill. Mr. S. Buxton states in reply that the concession will apply to all existing guarantees from April 30th last.

North and South Shields Electric Railway Bill.—This Bill came before a Select Committee of the House of Commons on Friday last week. It was explained that the measure was unopposed. The scheme is for an extension of time for the construction of the tube railway under the river. The promoters had not been able to proceed with the scheme for two reasons—financial matters had been bad and the chairman of the company had died just at the moment when the scheme was being got into water. The measure was allowed to proceed.

Royal Commission on Canals and Waterways.—This Commission met again on 9th inst., when Mr. J. A. Sauer gave evidence in support of the construction of canals from Hull to Liverpool, Liverpool to the Midland district, Bristol to the Midland district, Hull to the Midland district, and London to the Midland district at a cost of £9,690,000. He strongly recommended a scheme for connecting the central industrial districts with the great seaports.

Second Readings.—In the House of Commons on May 14th, the following Bills were read a second time:—Preston, Chorley, and Horwich Tramways Bill, South Lancashire Tramways (Extension of Time) Bill.

Third Readings.—In the House of Lords on May 14th, the following were read a third time:—Nottinghamshire and Derbyshire Tramways Bills; North Metropolitan Tramways Bill.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

10,016. "Improvements in and relating to dynamo-electric machines." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) April 30th.

10,024. "Improvements in the manufacture of arc light carbons." F. B. Laurent. April 30th.

10,036. "Improvements in the making of sparking or ignition plugs for use in gas or petrol engines and the like, for motor vehicles or other purposes." J. A. Mason. April 30th.

10,054. "Improvements in or relating to the production of high tension electric currents." O. R. von Bronk and A. F. A. Pieper. April 30th. (Complete.)

10,061. "Improvements in insulators for use in electric traction." H. V. Mitchell. April 30th.

10,097. "Method of and furnace plant for reduction of ores or the like by electric transformer furnaces." O. Frick. April 30th.

10,114. "Improvements in and relating to electric controllers." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) April 30th.

10,125. "Improvements in high frequency apparatus for wireless telegraphy, electro-therapy and the like." G. Bowron. May 1st.

10,038. "Improvements in dynamo-electric machines." J. E. Bennett. May 1st.

10,148. "Improvements connected with the rendering of overhead electric wires 'dead,' in the case of fracture." R. E. Wood and H. Wood. May 1st.

10,156. "Electric furnaces." H. L. Hartenstein. May 1st. (Complete.)

10,161. "Lining for electric or other furnaces and method of preparing the same." H. L. Hartenstein. May 1st. (Complete.)

10,172. "Improvements in overload and reverse current relay devices." F. Conrad. (Date applied for under Patents Act, 1901, May 8th, 1905, being date of application in United States.) May 1st. (Complete.)

10,188. "Electrical advertising novelty." H. E. Evans. May 1st.

10,208. "Improvements in methods of insulating electric conductors." The British Thomson-Houston Co., Ltd. (General Electric Co., United States.) May 1st. (Complete.)

10,218. "Improvements in party-line telephone systems." H. J. Roberts. (Date applied for under Patents Act, 1901, May 1st, 1905, being date of application in United States.) May 1st. (Complete.)

10,219. "Improvements in apparatus for the electrolytic decomposition of alkaline chloride solution by means of mercury cathodes." J. J. Rink May 1st. (Complete.)

10,220. "Improvements in brush-holders for dynamo-electric machines." The Morgan Crucible Co., Ltd., and C. W. Speirs. May 1st.

10,224. "Improvements in electro-magnetically operated valves." A. Gaudin and E. Tellier. May 1st. (Complete.)

10,249. "Improvements in a system for the transmission of electric telegraphy." I. Kitsee. May 2nd. (Complete.)

10,268. "Improvements in or relating to brushes for electrical machinery." F. H. Wyndham Hargreaves and J. Keefe. May 2nd.

10,283. "Circuit closing device for electric clocks and watches." C. Schwan. Date applied for under Patents Act, 1901, May 2nd, 1905, being date of application in Germany.) May 2nd. (Complete.)

10,297. "Improvements in or relating to electric switch and indicating apparatus." A. F. Berry and F. E. Berry. May 2nd.

10,298. "Improvements in tractors propelled by petrol or other types of internal combustion engines, likewise applicable to steam or other fluid pressure engines or electrical motors and machines driven thereby." H. J. Marshall. May 2nd.

10,310. "Improvements in electric heaters." J. F. Reilly. May 2nd. (Complete.)

10,327. "Improvements in electro-capillary apparatus." A. Orling. May 2nd.

10,339. "Improvements in interrupters for operating induction coils and the like." E. R. Clarke. May 2nd.

10,364. "Improvements in electrical fuse carriers for high-voltage circuits." V. Hope. May 3rd.

10,367. "Improvements in electrical advertising devices." J. Gibson and A. Brooker. May 3rd.

10,394. "Improvements in an accumulator or battery of secondary type." S. S. Chenhall. May 3rd.

10,396. "Improvements in electric furnaces for the manufacture of steel." G. Gin. (Date applied for under Patents Act, 1901, May 3rd, 1905, being date of application in Germany.) May 3rd. (Complete.)

10,397. "Improvements in secondary batteries." O. Lugo. May 3rd.

10,404. "Improved construction of masts for wireless telegraphy and other purposes." L. Leidl. May 3rd.

10,409. "An improved device for fixing disinfecting bodies to the mouthpieces of microphones." H. Kretschner. May 3rd.

10,457. "Process of manufacturing coils for electric purposes." R. J. Hoffelt. May 4th. (Complete.)

10,462. "Improvements in or relating to collecting fixed rent and rate charges and the like in connection with electric installations, and supplying electric current and apparatus therefor." F. H. Merritt. May 4th.

10,464. "Electrical tramway type-controller finger." D. Hodgson and G. W. Harvey. May 4th.

10,465. "Improvements in electrical switches." W. J. Furse and W. Woollatt. May 4th.

10,467. "An automatic switch for preventing excessive current in electric motors and circuits in which a variable electric current flows." A. Stewart. May 4th.

10,472. "Improvements in the manufacture of leading-in conductors for incandescent electric lamps or other vessels requiring gas-tight joints." A. C. Hyde. May 4th.

10,493. "Improvements in incandescent electric lamps." T. Mitchell, W. T. Gartland and H. Shone. May 4th.

10,543. "Improvements in terminals for accumulators." K. R. Smith. May 5th.

10,549. "Improvements relating to electrical switching devices." H. H. Lake. (The Stromberg-Carlson Telephone Manufacturing Cp., United States.) May 5th.

10,552. "Improvements in or connected with the conversion of alternating to continuous current." W. L. Spence. May 5th.

10,554. "Improvements relating to telephone switchboards." H. H. Lake. (The Stromberg-Carlson Telephone Manufacturing Co., United States.) May 5th.

10,558. "Improvements relating to telephone wall boxes." H. H. Lake. (The Stromberg-Carlson Telephone Manufacturing Co., United States.) May 5th.

10,565. "Improvements relating to telephone exchange systems." H. H. Lake. (The Stromberg-Carlson Telephone Manufacturing Co., United States.) May 5th.

10,576. "An improved method of connecting cables inside trolley standard brasses for electric tramcars and the like." A. Hanson. May 5th.

10,580. "Improvements relating to telephone exchange systems." H. H. Lake. (The Stromberg-Carlson Telephone Manufacturing Co., United States). May 5th.

10,585. "Improvements in alternating current electric motors." F. Punga. (Date applied for under Patents Act, 1901, May 5th, 1905, being date of application in Germany.) May 5th. (Complete.)

10,598. "Improvements relating to telephonic exchange systems." H. H. Lake. (The Stromberg-Carlson Telephone Manufacturing Co., United States.) May 5th.

10,599. "Improvements relating to telephone exchange systems." Particulars same as No. 10,598.

10,600. "Improvements relating to telephone exchange systems." Particulars same as No. 10,598.

10,601. "Improvements relating to telephone apparatus." Particulars same as No. 10,598.

10,602. "Improvements relating to telephonic systems and to apparatus therefor." Particulars same as No. 10,598.

10,603. "Improvements relating to telephone transmitters." Particulars same as No. 10,598.

10,605. "Improvements relating to electrical conductors and signalling thereby." E. W. Buckeridge and G. H. Buckeridge. May 5th.

10,610. "Improvements in electric arc lamps." J. Brockie. May 5th.

10,613. "Improvements in apparatus for the starting and reversing the direction of motion of electro-motors actuating elevators, hoists and the like." A. Jensen, H. J. Norballe and J. L. Lawson. May 5th.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1905.

Telephone Systems. H. H. Lake. (Direct Line General Telephone Co.) 4,362. March 2nd.

Electric Hoist Controllers. J. G. Childs. 4,625. March 6th.

Relay with Polarised Armature. L. Kamm. 6,744. March 30th.

Electric Motor Control Systems Applicable for Electrically Propelled Trains or Vehicles. British Thomson-Houston Co. (General Electric Co.) 7,149. April 4th.

Signals for Railways and the like. British Thomson-Houston Co. (General Electric Co.) 7,417. April 7th.

Relays for Electric Circuits. British Thomson-Houston Co. (General Electric Co.) 7,418. April 7th.

Construction of Electric Tramways. S. G. Bennett. 8,122. April 17th.

Method of and Means or Apparatus for Controlling Electric Switches and like Apparatus in Electric Current Distributing Systems. G. C. Fricker. 9,607. May 6th.

Flexible Support or Suspender for Electric Lamps and other Articles. R. W. Bill. 9,713. May 9th.

Apparatus for Use in Regulating the Load on Direct Current Electrical Generators. E. S. W. Moore and W. G. Strang. 10,639. May 22nd.

Switching Devices for Use in Electric Flash Advertising. L. K. Job. 10,707. May 22nd.

Microphonic Diaphragms Coupling for Phonographs, Gramaphones, and others. M. Mondragon. 13,150. May 26th.

Electric Organ Actions. H. C. E. Jacoby. 14,461. July 13th.

Electric Arc Lamps. W. C. Johnson and M. P. Thomsen. 16,301. August 10th.

Electric Arc Lamps. British Thomson-Houston Co. and E. J. Murphy. 16,657. August 16th.

Process for the Electrolytic Production of Copper. J. A. W. Borchers, F. E. Gunther and P. R. Franke. 19,638. September 28th. (Date applied for under International Convention, October 4th, 1904.)

Actuating Devices for Magneto-Ignition Apparatus. Magnetzünder-Gesellschaft Unterberg & Cie. 22,121. October 30th. (Date applied for under International Convention, February 28th, 1905.)

Electric Joint Boxes. J. H. C. Brooking. 23,241. November 13th.

Electrodes for Electrolytic Apparatus. F. W. Howorth. (M. Kellner, E. Kellner, E. Kellner and M. Kellner.) 24,598. November 27th.

Röntgen Ray Apparatus. W. C. Fairweather. (Firm C. H. F. Müller.) 25,612. December 8th.

System of Electrical Distribution. R. M. Palmer. 26,149. December 15th. (Date applied for under International Convention, December 22nd, 1904.)

Ignition Devices for Explosion Engines. J. P. Fox. 26,237. December 16th. (Date applied for under International Convention, October 25th, 1905.)

Electric Current Reversing Switch, Lamp Socket and Plug Combined. H. Rodes, H. R. E. Perkins and J. Blakey. 7,197. April 5th.

Electric Motors and Means for Preventing Sparking in Same. M. Pfatischer. 7,286. April 6th. (Date applied for under International Convention, April 7th, 1904.)

Variable Speed Electric Motors. M. Pfatischer. 7,286A. January 24th. (Date applied for under International Convention, April 7th, 1904. (Originally included in No. 7,286/05.)

Flexible Armoured Electric Cables. W. C. Johnson and S. Paterson. 7,842. April 12th.

Trolleys for Electric Railways, Tramways and the like. A. P. Zani. 8,090. April 15th.

Electric Wiring and Controlling Systems. A. Blackmore. 8,805. April 18th.

Electricity Meters. J. D. F. Andrews. 8,391. April 19th.

Electric Lighting of Railway Carriages and other Vehicles. Electric and Ordnance Accessories Co. and R. F. Hall. 9,479. May 5th.

1906.

Thermal Electric Switch. W. van Doren Kelly. 374. January 5th. (Date applied for under International Convention, August 30th, 1905.)

Suspension of Current Conductors of Electrical Railways. P. Platte. 619. January 19th. (Date applied for under International Convention, January 10th, 1905.)

Storage Battery Electrode. T. A. Edison. 1,925. January 25th. (Date applied for under International Convention, March 30th, 1905.)

Suspension of Current Conductors of Electrical Railways. P. Platte. 3,572. February 13th. (Date applied for under International Convention, September 28th, 1905.)

Electrode Mass for Storage Batteries and Process of Forming the Same. T. A. Edison. 1,927. January 25th. (Date applied for under International Convention, February 8th, 1905.)

Telephone Holders. C. H. Borden. 615. January 9th. (Date applied for under International Convention, March 1st, 1905.)

Controlling Means for Vapour Electric Apparatus. P. C. Hewitt. 706. January 10th. (Date applied for under International Convention, January 20th, 1905.)